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Dr. BOERHAAVE'S Academical Lectures ON THE Theory of PHYSIC.

BEING

A Genuine Tranſlation of his

INSTITUTES

AND

Explanatory COMMENT,

Collated and adjuſted to each other, as they were dictated to his STUDENTS at the Univerſity of *Leyden*.

VOL. I.

Containing the *Hiſtory* of PHYSIC, and the Oeconomy of the ſeveral Parts ſubſervient to *Chylification*.

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THE PREFACE.

THough the deſerved Reputation of our learned Author, with the apparent Accuracy and Importance of this Work, may render any Apology for its Publication abſolutely unneceſſary; yet the Reader may perhaps expect ſome Reaſon for its appearing in this manner, collated and tranſlated into Engliſh. For this, it is obvious to every one that knows any thing of our Author's Stile, that his great Conciſeneſs, whereby he repreſents a Multitude of Idea's in a ſmall Compaſs, is of itſelf more than ſufficient to engage the whole Attention of tolerable Capacities, without any additional Embaraſsment from a Language, in which the Engliſh muſt be allowed to be leſs converſant than in their own; inſomuch that a late emi-

nent Writer in Physic * *laments* that the concise Accuracy wherewith our Author has wrote should prevent his being generally read. *It is therefore with a View of rendering this Work of general Use to those who are unhappily ignorant of the* Latin *Original, as well as to facilitate it for such as are in some measure acquainted therewith, that we have stript off its foreign Dress, and adjusted the Text and Comment, by exhibiting them together; which last is an Advantage never yet offer'd to the Public in any Language. So that the Candidate for Physic is here presented with the best Method of initiating himself into so difficult a Profession, that has ever yet, or will perhaps hereafter appear at any time in the World; containing not only the whole Learning of the Ancients, but also the immense Treasure of all our modern Discoveries relating to the Subject; and this too in a Method and Language the most easy, familiar, and intelligible; that tho' the Student is now unfortunately deprived of being instructed by the Professor himself in Person, yet he may hereby more leisurely and distinctly reap the same Advantages, without either the Expence or Fatigue of leaving his Country.*

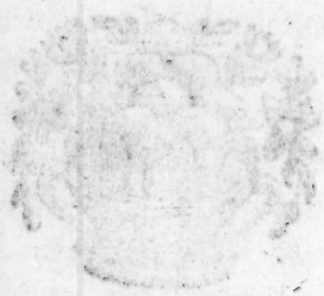
The Work in itself seems to be as well adapted for the Service of the more Advanced as it is for Beginners; since the first may be satisfied with refreshing their Memories by reading the Text only, which will to them appear sufficiently evi-

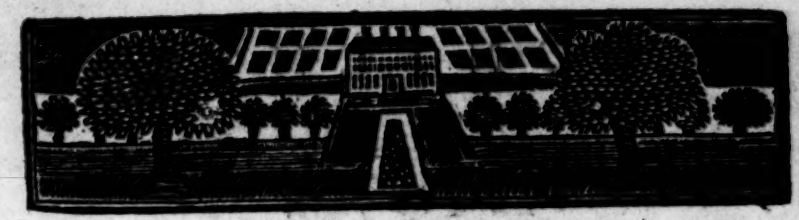
dent,

* Dr. *Quincy*, Lexic. Medic. under the Word *Institution* and *Aphorism*.

dent, without diving into the particular Notes, that may be often found neceſſary to inform the younger Student; but if the Notes or Comment ſhould appear to the former in any Place to be more defective, or leſs accurate than the Text, there is no Judge ſo ſevere, but will readily make ſome ſmall Allowance, in conſideration that the one was an extemporaneous, but the other a ſtudied Diſcourſe. To conclude: If the preſent Tranſlation of the Text ſhall appear more correct than others, and the Publication of the Whole as generally uſeful as intended, it may encourage and haſten the Edition of the Remainder in the ſame manner with this firſt Volume.







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ERRATA.

Page 105. Line 11. read *Cerealia.*
— 115. —— 14. for prepare read *prefer.*
— 116. —— 14. for and read *to.*
— 124. —— 24. read *Sphenoides.*
— 130. —— 26. read *Styloglossi.*
— 134. —— 19. read Alterations *from.*
— 151. —— 17. for Fat read *Face.*

INTRO-

INTRODUCTION.

Concerning the Origin, Progreſs, and different States of Phyſic.

THE Student that applies himſelf to Phyſic, is, from the Nature of the Science, obliged to be acquainted with every Truth that has been advanced in the ſeveral Branches of that Faculty, as well by the Ancients as the Moderns; and when theſe are once apprehended, he ought carefully to add to 'em his own particular Obſervations; regiſtering them in his Mind, in the ſame Condition as they appear'd to his Senſes.——To learn theſe Truths and Diſcoveries, he ſhou'd begin firſt with the *Inſtitutions* of Phyſic; which comprehend the Knowledge of every thing neceſſary for the Preſervation of Health, and the Cure of Diſeaſes. After which, he may proceed to the *Practice*; which is the putting thoſe Precepts, which he has before learned, in force upon his Pa-

tient.—The Ancients, and ſome of the Moderns, have injudiciouſly excluded every thing from the Inſtitutions of Phyſic, which has not ſome relation to the animal Oeconomy. But a Phyſician, who follows the Practice, ought certainly to be verſed in the medical Idiom or Language uſed by the practical Writers, if he wou'd underſtand what is offer'd to his Attention: and the ſudden Calls for his Aſſiſtance will not then admit of any Delays for Information. Thus the Hiſtory of Inflammation cannot be ſeparately underſtood, without a previous Idea of Obſtruction, joined with the whole Doctrine of the conical Artery, receiving Blood from the Heart. A Phyſician ought therefore to be furniſh'd with a juſt Notion of all Diſeaſes before he ventures upon the Practice; that when he comes to a Patient, he may readily diſcover his known Diſorders by their proper Signs.——But prefatory to theſe Inſtitutions, it ſeems agreeable to add an Introduction concerning the Hiſtory of Phyſic: for it muſt be well worth a Phyſician's Notice, to be acquainted with the Advances by which our Profeſſion has arrived at its preſent State; and no leſs entertaining to take a View of the ſeveral Faces with which Phyſic has appear'd in different Ages.

§. 1. The Perſon who can perform the ſeveral Actions proper to the human Body with Eaſe, Pleaſure, and a certain Conſtancy, is ſaid to be well; and that Condition of the Body is termed Health.

§. 2. But if he either cannot perform thoſe Actions; or if he performs them but with Difficulty, Pain and ſudden Wearineſs; he is then

then ſaid to be ill: and that State of the Body is call'd a Diſeaſe.

The Contents of the two preceding Sections appear ſo ſimple and common, that ſome may imagine them not at all pertinent to the Art of Phyſic; yet they ought not to be neglected: for it is from the Inability itſelf to perform any of the Actions proper to the human Body, that we arrive at a Knowledge of the immediate Cauſe of that Inability. Thus a Pain in breathing denotes a Pleuriſy; an Inability to move any Limb at pleaſure, a Palſy, *&c.*——'Tis a good Cuſtom among the *Turks*, that when they have called a Phyſician, they will not follow any of his Directions, till he has firſt told the Patient what his Diſorder is.

§. 3. Now the Injuries of Weather, with the ſudden neceſſary and unavoidable Changes in the *Air*[1]; the Nature of ſolid and fluid *Aliment*[2]; Accidents from *Violence*[3]; the very Actions of *Life*[4]; and even the *Structure*[5] of the human Body itſelf, muſt have ſubjected our Species to Diſorders ever ſince they have lived *as we do*[6].

[1] A Fluid, ſo abſolutely neceſſary to Life, that we cannot ſubſiſt two Minutes without it; yet is it ſometimes ſo deadly and peſtiferous, that it often brings Diſeaſes, and Death itſelf, without any other Cauſe.——The Air is a confuſed Mixture of all Bodies. The Seeds of all Vegetables float in it. Gold itſelf, tho' ſo ponderous, may aſcend in it to the Height of fifty Foot; which is demonſtrated by Chemiſtry. The Air is fill'd with the va-

rious *Exhalations* which aſcend from the Earth, ſome of which ariſe in the Morning, others at Noon; but both very different from thoſe which deſcend in the Night.—The *Stars* themſelves produce various Changes in the Air: the *Sun* and *Moon* eſpecially have a great Influence on the Atmoſphere. The freezing Nights ſucceeding ſultry Days in *Meſopotamia*, were trying to the Conſtitutions of our Forefathers: tho' nothing cou'd be more healthy than the temperate Air of *Ægypt*; but for *China* and *Eaſt-India*, which were inhabited by the other ſucceeding Families, the one is unhealthy by its Fogs, and the other by its violent Heat.—To theſe add, the various Changes made in the Air by the different Seaſons of the Year, Meteors and Winds, which are very frequent in the hotteſt Countries. The ſudden Difference between a hot ſultry Air, and a cold, heavy one, ſo much impedes Perſpiration, that it muſt neceſſarily cauſe various Diſorders, even ſo as to kill nine out of ten, if we may believe *Sanctorius*. The nocturnal Air in particular muſt have a very conſiderable Effect on our Bodies; becauſe in the Night, the watery Vapours, raiſed from the Earth by the diurnal Heat, are condenſed and deſcend by their own Weight. I have known Men of *Herculean* Strength flung into incurable Rheumatiſms from the cold of one night, which has been taken by ſleeping in the wet Graſs.—The Winter Air, is more healthy than the Summer; becauſe the frozen Surface of the Earth keeps in the Vapors which would otherwiſe aſcend from it. But the Earth opening its Pores in the Spring ſends forth its Exhalations, which are very pernicious to Mankind, if it were only by their inducing the ſudden Changes of heat and cold.

Our

[2] Our firſt Parents were ignorant of the Nature of Eſculent Plants, Fleſh and Garden Fruits; they made tryal upon all, and by woful Experience they learned to diſtinguiſh the deadly from the wholſome: As, in our Times, Sailors in their Voyages to remote Countries, run the Hazard of uſing unknown Aliments. And again, the Aliment which is healthy for a ſtrong Conſtitution in a cold Air, will be inſuperable to a weak Perſon in a warm Air. Nor were the firſt of Mankind ſenſible, till they had experienced, that by the taking of cold, though pleaſant, Aliments into their Bodies while very hot, and in ſuch a warm Air, there was Danger of cauſing a preſent Pleuriſy and Death.

[3] Falls, Strains, unforeſeen Accidents, Stones and Trees blown down by Tempeſts, *&c.* gave birth to Chirurgical Diſorders. The Want of Mechanical Engines, and the Irregularity of the Ways thro' dangerous Mountains, ſtill increaſed theſe Accidents among the firſt Race of Mankind. Nor was War ever ſilent for any conſiderable Time; ſince we are ſupplied with an Inſtance of it between *Cain* and *Abel*, two of the firſt three Men in the World.

[4] The mere Actions of Life will conſume the Body equally with the moſt acute Diſeaſe: Hunger can be bore but for a few Days, and Thirſt but for a few Hours; if Matter is wanting in the Habit to ſupply the bodily Decays: And this Abſtinence kills the ſooner, as the Body is ſtronger and uſed to a more plentiful and ſubſtantial Diet. For the ſtronger the Habit of Body, it is ſo much the more obnoxious to the moſt acute Diſeaſes. A moſt ſevere Peſtilence may be cauſed in a Perſon barely by too much Motion of the Body. I ſaw

a Man that was order'd to carry Letters in haſte to *Utrecht*, who, by exceſſive running, ſo forced the groſſer Parts of his Fluids into the ſmaller Veſſels, as to render the Obſtructions incorrigible by any Art. Reſt and Motion of the Body ſhou'd never exceed proper Degrees, which was a Thing altogether unknown among the firſt race of Mankind.

5 So ſmall, thin and tender, are the greater Number of the Veſſels in a human Body, that it is more a Wonder they hold out as they do, then that they are ſo frequently diſordered. The largeſt Artery, in the Coats of the ſmalleſt ſanguiferous Artery, is equal to the tenth Part of the Thickneſs of a Spider's Thread: But that ſmall Artery is an *Aorta* with reſpect to a ſmall Artery in the cortical Subſtance of the Brain. Thro' the narrow Orifices of theſe ſmalleſt Veſſels the various Fluids in our Bodies are continually propell'd with a very great Velocity, by which means there is a mutual Attrition produced between the Parts of the circulating Fluids and the Sides of their Veſſels, and ſo the Action of Life deſtroys itſelf. Thoſe Veſſels which we find ſo very ſmall in an Adult, were ſo much ſmaller in the Fœtus as the Adult is larger than the Fœtus: For in a Conception of but two Weeks old, there are none of thoſe Veſſels wanting which will be poſſeſs'd by it when adult. How eaſily, then, may theſe tender ſolids be diſordered.

6 There is here no Occaſion to enter into Doubts about the State of Innocncy, which ſeems to have been ſhort, and in which the human Body was not ſubject to the preſent Accidents, nor its Structure the ſame; ſince the Powers we now find in it ſeem inſufficient to preſerve it in the State mention'd.

§. 4.

§. 4. The Species were no ſooner thus inſulted with Diſeaſes, but the Preſence of thoſe Diſeaſes in the Body irritated it to exert a Sort of Mechanical Impulſe, or inconſcious *Automatic*[1] Motion, for their Removal: Which Sort of Automatic Endeavours of the Body to recover itſelf, are found by ſtrict Obſervation to be exerciſed as well in Brutes, as rational Animals; notwithſtanding the Cauſe of that Motion is undiſcoverable by human Reaſon, no other being aſſignable than the Will of the great Author of all Things.

[1] An Automaton is a Machine that performs various Motions without any other Cauſe than the Mechaniſm of its own Parts within itſelf; which, when once put in Motion, continue ſo, from the ſame Cauſe. Thus a Watch is an Automaton, which, whilſt in Order, moves round its Hands by the determinate Motion of its internal Parts. By an automatic Motion, or Impulſe, we therefore underſtand that Motion which reſults from the mechanical Structure of the human Body, which we can neither produce nor deſtroy by the Influence of the Mind or Will. It is certainly true, that ſuch a kind of Motion does exiſt in our Bodies, how much ſoever it may be diſpleaſing to ſome Philoſophers. The human Body is an Aſſemblage of ſmall elaſtic Solids, by whoſe conjunct and regular Actions, Life and Health are produced. The Head or firſt Spring of Motion, in theſe elaſtic Solids is the Heart, which continues its alternate Contractions and Dilatations ſo long as the Animal lives. But even the ſmaller elaſtic Solids, which are every where continued throughout the

Body, have a Power by which they endeavour to reſiſt and overcome every thing injurious to the Oeconomy. Suppoſe a human Body, in a great Heat by violent Motion, to be ſuddenly expoſed to cold: The Blood would certainly be, by that means, coagulated and its Motion ſtopp'd in the ſmaller Veſſels, if it were not for the Nature or inſenſible Action of the Solids; *viz.* a ſudden Contraction of all the cutaneous Pores, whereby they exclude the injurious Action of the cold. When Poiſon has been taken, the Animal muſt inevitably periſh, if its Force gets into the Blood, or its Action continue long upon the Viſcera; but provident Nature, or this automatic Motion generally does, what every expert Phyſician ought firſt to do, *i. e.* ejects it by Vomit. Nor is the Mind able to ſuppreſs theſe automatic Endeavours of our Machines for Self-preſervation. Suppoſe one Friend tells another, that he is only going to threaten him with a Blow upon the Eye; and therefore bids him endeavour not to ſhut it at the Offer: The Mind is at that Time ſecure from Danger; but the ſpecious Offer is no ſooner made, than the Lids of that tender Organ are cloſed, notwithſtanding all the Reaſons and Reluctancy of the Mind to the contrary. Suppoſe a Piece of Glaſs, *&c.* enter thro' the ſkin, if it be not extracted, it will by its Hardneſs and Acuteneſs always deſtroy the ſoft Parts in contact; therefore a Suppuration follows, that the injurious Body may float in a Cavity full of inſenſible Matter, without offending the Solids, and be afterwards diſcharged. The conjunct Power of all theſe Actions of the Body for preſerving its own Health, which ariſes from the wonderful Structure of its Parts, is what *Hippocrates* calls NATURE; to which he aſcribes ſo many

ny and great Efficacies, and to mention one out of a Multitude, the Criſes in acute Diſeaſes. There is not any one Diſeaſe but receives Helps from this automatic Motion, which is exerted throughout the whole Progreſs of a Diſorder, tho' it be inconſcious to the Mind.—Even this ſame Principle is no leſs obſervable in Brutes. The Dog devours Graſs to looſen his Inteſtines, and expel their dry and chalky Fæces; nor will he eat any kind of vegetable but his own Sort of Graſs. Poultry that live upon ſolid Grain, too compact to be comminuted barely by the Strength of their Stomachs, ſwallow little Stones, which are rough, and perform the Office of Teeth in their Stomachs, upon that ſolid Aliment: And Poultry that are ſick generally retire into Holes, where they pick Mortar from the Walls to obtund the offending Acidity in their Stomachs.—In *Aſia* there is a little Animal in Figure like a Lion, which if it happens to be bit in its Conflict with the Viper, it has recourſe to a Plant called Mungos, upon which it tumbles and revives itſelf; and then briſkly returns to the Serpent and overcomes it: Nor were Men acquainted with the alexipharmic Virtue of this Plant by any other means.—So *Melampus*, the moſt ancient of the *Greek* Phyſicians, of *Argos*, when he obſerved that Sheep who fed on black Hellebore had a Looſeneſs, he transferr'd the Uſe of that Medicine for the like Purpoſe in Men, and the Plant for many Ages after bore the Name *Melampodes*. By theſe Methods Mankind doubtleſs acquired a conſiderable Notion in Healing. —In like manner the uſeful Hœmorrhages which naturally broke out in acute Diſeaſes, encouraged Phlebotomy; a Remedy which muſt of itſelf appear otherwiſe threatning and cruel.—If a little

Sand

Sand falls into the Eye, we find the Eye-lids are quickly and ſtrongly contracted, and the Eye by that means thruſt further into the Orbit; whence the large lacrymal Gland being compreſs'd by it, a Stream of Tears follow to waſh out the Sand, and abate the Inflammation cauſed by the Friction and Pain in that tender Organ. But what can be more ſimple and eaſy than to imitate Nature, by injecting ſome warm and mild Liquor, to waſh out the foreign Bodies and abate the Inflammation cauſed by their Roughneſs.

[2] In vain muſt a Phyſician endeavour to account for an Appearance in Nature, the Cauſes of which he is ignorant; as we are aſſured by the different Effects of Medicines. The human Body has a Faculty of rejecting every thing foreign to its Nature, in common with all Animals, Vegetables, and even Metals; for Gold in its Element, or Mine, will not join itſelf to any thing that will not turn to Gold. The Facts are certain, and obſerved by the Reſearchers of Nature; but in vain do we ſtrive to explain their Cauſes.

§. 5. Another Principle differing from the former, was the uneaſy Senſation in the Mind, cauſed by the impeded Action itſelf of any Member; or the Torment of Pain, irritating any diſorder'd Part, and oppreſſing the Mind with Grief: This excited the Mind alſo to ſearch after, and apply Remedies fit to remove thoſe Impediments; which Remedies were hit upon either by natural Inſtinct, or by promiſcuous Experiment.

Theſe Endeavours of the Mind proceed from its being impatient of Pain, ſtriving by all the Means

Means it can think of to obtain Eaſe: nor is it a Principle in common with, but quite diſtinct from that of the automatic Motions of the Body, §. 4. —Theſe Endeavours of the Mind for Eaſe are reducible to two Claſſes. To the firſt belong *promiſcuous Experiments made without Reaſon or Obſervation:* as by ſtriving to eaſe a Part by variouſly changing its Situation, applying any thing to a Wound or Burn that comes firſt to hand, *&c.*— When any thing falls into the Eye, a Stream of Tears will flow from the automatic Motion, to waſh it out; but the Mind being uneaſy at the Senſe of Pain, will alſo uſe its Endeavours by various Trials; as applying the Hand to the Eye, and rubbing the Eye-lids, *&c.* and ſo forwards the Actions of the preceding. If a Perſon has a Pain in his Side, he will diſpoſe himſelf in various Situations till he acquires the moſt eaſy. And when any of theſe Trials have proved ſucceſsful, they will be remember'd and talk'd of by the Patient: and hence aroſe the firſt Rudiments of Phyſic.—The other Claſs of theſe Endeavours of the Mind for Eaſe, is, when it oppoſes Diſorders with Remedies to which it is directed by *Reaſon, Obſervation, or the Nature of Things.* Thus the beſt Remedy for a Man fatigued with great Heat and violent Exerciſe, is what will dilute the Blood and mitigate the Acrimony to which its Salts are inclining; but if we attend to the Appetite; we ſhall find it deſires for this purpoſe a cool, watery and acidulated Drink. And as moſt Men die from the Want of Fluidity and Obſtruction of the Blood; it frequently happens, that from this Appetite the Sick will have a ſtrong Deſire for cold Water before Death; the careleſs Phyſician at that time neglecting to take notice of the Appetites, which point to the

the immediate Cauſe of the Diſeaſe. Theſe Endeavours belong to the Mind; and even in Brutes we cannot attribute them to the Body: for the Body of a Perſon aſleep, or in an Apoplexy, takes no Concern for Aliment, or other Wants. There are many extraordinary Appetites to uncommon Food, in ſeveral Diſorders, to be attributed to this Principle; which Diſorders are by that means frequently brought to a Period. A Perſon in an acute Fever longs for Grapes, or to be in the Cold; his Friends diſſuade him, his Attendants deny them to him: however, he happens to get his long'd-for Dainty, and returns with his languid Fibres braced up, or a looſe Belly, diſcharging the obſtructing Viſcidities; and thus gets well. A rich Patient of *Amſterdam*, and a liberal Rewarder of the Faculty, longed for pickled Herrings: his Phyſicians refuſed them; yet he ventured on 'em, and was cured: the Hiſtory is extant in *Tulpius*; and there are a hundred Inſtances of the like Nature, in Dropſies, intermitting Fevers, *&c.* to be met with in the Writers of Obſervations. The Girl that has a Chloroſis eats Chalk, Fuller's Earth, or other earthy Subſtances which obtund Acidities: this Appetite is bad with reſpect to a healthy Body; but in that preſent Diſorder it directs to a proper Remedy. There are ſo many Hiſtories of Succeſs in moſt Diſorders from the Gratification of longing Appetites, that I think a Phyſician ought not inconſiderately to deny them. Nor ought any body to accuſe me from hence, with having ſuppoſed our Machines to be acted by a ſort of fatal Neceſſity, contrary to a free Agency. I only deduce Conſequences from Facts, and aſſert what I have experienced; being firſt certain of their Cauſes and Effects: than which, I know no other way to Knowledge.

§. 6. From

§. 6. From theſe Principles (§. 4. and 5.) the Art of Phyſic or Healing took its firſt Riſe; and in that Senſe (§. 4. and 5.) it was at all Times and in all Places practiſed by Mankind.

Natural Phyſic, as deſcrib'd at §. 4. and 5. was practiſed by Mankind at all Times and in all Places; for the Species were never exempt from Diſorders (*per* §. 3.) and Means to remove thoſe Diſorders were ſought after in all Ages (*per* §. 5.) therefore natural Phyſic was always in Practice; and no Man was ever deprived of natural Inſtinct. But the Art of Phyſic eſtabliſh'd by human Knowledge is of a much later Date, for there were not always People who imitated and improved the Method of Healing barely founded on Nature. But human Minds are not limited to the Sphere of Inſtinct, which only conſiders preſent Objects, for that is the State of Brutes; but by comparing paſt Objects with thoſe that are preſent, it can attain to the Knowledge of future Events. From an Obſervation of the Appearances in the Heavens, continued ſeveral Ages, aroſe the Art of Aſtronomy; till at length they could as certainly foretell an Eclipſe Ten Years to come, as the daily riſing and ſetting of the Sun. In the ſame manner began Phyſic, when a Perſon could diſtinguiſh Diſeaſes, and had obſerved what good Events had happen'd in them from Art, Accident, or Nature; whence he could infer and ſafely pronounce, "a "Hundred have been cured of the Diſeaſe which "appears with theſe Signs, by ſuch a Medicine; "and it will be ſo in you, my Patient." This Art of predicting might be greatly favour'd by the

Longævity

Longævity of our Forefathers, by which they were capable of an infinite Number of Experiments, and ſo might be furniſh'd with an infinite Number of Caſes by their own Memories, which our ſhort-liv'd Generation is obliged to ſupply from the ſtanding Obſervations of others.

§. 7. From the moſt early Accounts of *Hiſtory* [1] and Fable, we learn that the Art of Phyſic or Healing was firſt cultivated, ſo as to prevent future and cure preſent Diſeaſes, amongſt the *Aſſyrians*, *Babylonians*, *Chaldeans* [2], and *Magi*; from theſe it came into *Egypt* [3], *Lybia*, *Cyreniaca* [4], and *Croto* [5]; and thence it was carried into *Greece* [6], where it principally flouriſh'd in the Peninſula of *Cnidos* [7], and the Iſlands of *Rhodes* [8], *Cos* [9], and *Epidaurus* [10].

[1] It is no eaſy matter to determine the Time when Phyſic firſt appeared as an Art, or, which is the ſame, when a ſelect Number of Men took upon them the Care of their Fellow-Citizens Health; yet we ought to diſtinguiſh or claſs the Times of its Advances according to the Accounts given us. The firſt and moſt early of which we can only gueſs at from the nature of the thing, having no Accounts of thoſe Men and their Tranſactions this way. The ſecond is fabulous, the Monuments of which we poſſeſs, but deform'd with Rhetoric, and other arbitrary Ornaments. And the third is hiſtorical, taken from the Commentaries of ſerious and learned Hiſtorians.—It is probable that before and after the Flood there were a few old Sages more

more particularly curious and delighted with examining their own and others Diſorders than the reſt, who from their Curioſity made ſtill better Obſervation of what uſually cauſed and cured thoſe Diſorders; that there were ſuch, we learn from Fable, the moſt ancient kind of Hiſtory, which tells us of one *Phœbus* or *Solus* in this Character; but this *Phœbus* was *Horus* King of the *Aſſyrians*, who, according to *Pliny*, was the Inventor of a particular Medicine; and the Word *Horo* ſignifying Light in the oldeſt of Languages, *Hebrew*, does alſo confirm that he and *Phœbus* were the ſame.— But it is probable that the Art of Healing took its firſt Riſe in *Meſopotamia*, or not far from it, becauſe there was the Birth or firſt Seat of Mankind, and there was fix'd the firſt Kingdom that was framed; in that happy and temperate Region our long-liv'd Forefathers invented moſt Arts. But from thence Phyſic paſſed with Aſtronomy and Languages into *Phœnicia*, and from *Phœnicia* it might ſpread into *Egypt*; but that *Egypt* did not produce the firſt Cultivators of Arts, may be judg'd from the Nature of the Country, which was uninhabitable till they had made it ſo by artificial Motes and Banks. And even many Ages after that, in *Aſſyria*, we find the Art no further advanced than for one Neighbour to help another in his Illneſs; which was the firſt Method of practiſing Phyſic.

[2] The *Chaldeans* were the firſt Colonies that ſettled in *Aſſyria*, and their Rulers and Judges were called *Magi*, who formed the Precepts of their Knowledge into Verſes, being Maſters of every Science; ſince their very Kings were not permitted to rule unleſs they had been learned of the *Magi*, as we are inform'd by *Pliny*. Among theſe *Magi*, *Zoroaſter* was one of the moſt conſiderable, whom

whom Superſtition has rank'd among the Number of diabolical Sorcerers, thro' the perverted or miſtaken Senſe of the Name *Magi*, or Magicians; much in the ſame manner as the *Romans*, hating the ſeditious and threatning Enquiries of Aſtrologers, expell'd all that bore the Name of Mathematician out of *Italy*. Length of Time has buried from us the Learning of the *Chaldeans* in Oblivion. The vaſt Number of Books which contained the Learning of the Eaſtern Nations, ſhared the Fate of periſhing with their regal Cities, as *Niniva*, *Jeruſalem*, *Babylon*, *Perſepolis*, and *Alexandria*; what now remains to us is but little, and muſt either be taken from *Herodotus*, or deduced from Conjecture. The Writings we poſſeſs of *Sanchoniathon* and *Beroſus* on this Head are imperfect, and for the earlieſt Part of their Hiſtory, we have no Account but in the ſacred Scripture. The oldeſt Hiſtorian is *Moſes*, next to his follows the Book of *Joſhua*, then the Author of the Books of *Kings*, and the *Apocrypha*; and after them come the Writings which remain to us of *Sanchoniathon*, which to our great Trouble are very imperfect. At a long Interval from the preceding came *Herodotus*, who was followed by *Thucydides* and *Xenophon*. That there were Phyſicians in the Eaſtern Parts, is confirmed by the Accounts of *David* (1 *Kings* i. 3, 4, 5.) and *Aſa* (2 *Chron.* xvi. 14.) but that they were not famous in the Time of the *Perſian* King *Darius Hyſtaſpis*, ſeems to follow from his not ſending for his own Country, but *Egyptian* Phyſicians when he had luxated his Foot.

§ The *Egyptians* made great Advances in Phyſic; for their Prieſts, who were Interpreters between the Gods and Men, and even their Kings, approved of the opening of dead Bodies, to find out

out the Cauſes of Death; but that and the reſt of their Sciences they kept as hidden Secrets, wrapt up and conceal'd in obſcure Figures or Hieroglyphics. That the Office of Phyſician was very ancient among the *Egyptians*, may be learn'd from the ſacred Scripture, where it tells us, that when *Jacob* dy'd in *Egypt* his Body was embalm'd by *Joſeph*'s Phyſicians. But that the Number of their Phyſicians was very great, will appear from but one ſingle Part of the Body being aſſign'd for the Province of one Phyſician; ſome took upon them the Care of the Eyes, others the Ears, and others different Parts of the Body; ſpending their whole Lives in the Knowledge and Cure of the Diſorders of each Part, and being ſubjected to Puniſhments or Rewards according as they acted: ſo that *Egypt* proved another native Country to Phyſic, from whence the great *Plato*, *Thales*, *Laertius*, and particularly *Democritus*, and all *Greece*, acquired their Skill, according to their own Confeſſions. The *Egyptian* Learning ſuffered greatly by the cruel Wars under the *Pharaoh Necho's*, *Hophra*, and *Pſammenites*, when *Egypt* was firſt ſubdued by the *Aſſyrians*, and afterwards by the *Perſians*; inſomuch that the *Egyptian* Phyſicians belonging to the Court with Difficulty eſcaped the Sword, at the Requeſt of *Democedes* of *Croto*, when they had in vain attempted to reduce the luxated Foot of King *Darius*, Son of *Hyſtaſpes*. But afterwards *Egypt* aſpired to its former Glory in this Science, when in following Ages flouriſh'd *Herophilus*, *Eraſiſtratus*, *Ammonius*, *Dioſcorides*, and others, who were ſo well ſkill'd in all the Parts of Phyſic, that ſuch as deſired any Knowledge in that Faculty, reſorted to learn of them from all the Countries around them.

[4] *Cyreniaca* was a happy Province amidſt the barren Sands, which produced, among other Philoſophers of celebrated Name, *Ariſtippus*, *Eratoſthenes*, *Callimachus*, and *Carneades*; but no conſiderable profeſs'd Phyſician: tho' after the *Crotonians*, the *Cyrenians* were firſt concern'd in Phyſic there. In that Place alſo grew the famous Plant *Silphium*, which was expreſſed, as a particular Gift of the Gods, upon the Coin of *Battus*, the *African* King, who built *Cyrene*.

[5] At *Croto* flouriſhed the *Pythagorean* School, which produced the Phyſician *Democedes*; who, upon the Slaughter of the Tyrant *Samius Polycrates*, whom he attended, was brought into *Perſia*, where he recovered the luxated Foot of *Darius* by applying Mallows, after it had been made more difficult to cure by the bad Treatment of the *Egyptian* Phyſicians. There he alſo cured an Ulcer in the Breaſt of *Atoſea*; but being advanced with much Wealth and Honour, he affectionately returned afterwards to his own Country, charged with the Embaſſy of the firſt *Perſian* War. But when the Philoſophers were expell'd from *Croto*, and the *Pythagorean* School burnt thro' Malice, another was erected at *Metapontus*.

[6] Phyſic ſeems to have paſſed into *Greece* from *Egypt* in the Time of King *Amaſis*, under whom *Egypt* drove a conſiderable Commerce with *Greece*, as we are informed by the *Attic* Laws brought out of *Egypt* by *Solon*. The Fame of Phyſic in *Greece* was very inconſiderable at firſt; the moſt ancient Phyſician that was a Native *Greek*, ſeems to have been *Melampus*, who having found out the Nature of Hellebore by obſerving its Effects on Goats, cured the Daughters of King *Proetus* of an hyſteric Phrenzy, which made them imagine themſelves changed

changed into Cows, leaving afterwards his own Name to that ſalutary Plant.

[7] *Cnidos* was a City in the leſſer *Aſia*, which ſeems to have taken the Art of Phyſic from their neighbouring *Aſſyrians*; in that City flouriſhed a celebrated medicinal School, as *Galen* tells us, whoſe Methods of Healing are often quoted by *Hippocrates*, who has from thence reſerved to us many Monuments concerning the ancient State of Phyſic; and this probably might give Riſe to that falſe Reflection upon this Father of Phyſic, *viz.* that *Hippocrates* ſtole his Obſervations from the *Cnidian* Temple, and afterward ſet it on fire to conceal his Plagiary, by which he appropriated the Wiſdom of his medical Anceſtors to his own Pen. But the *Cnidian* Phyſic ſeemed principally to conſiſt in a ſtrict Obſervation of the antecedent and conſequent Symptoms of Diſeaſes, without deducing any Indications from them, or referring particular Diſeaſes to their general Cauſes; for which *Hippocrates* deſervedly reprehends them.

[8] *Rhodes* was an Iſland celebrated for the Ingenuity of its Citizens, for their Study in Navigation, and the Healthineſs of its Air, being *Tiberius*'s wiſh'd-for Place of Exile; it ſome Time enjoy'd a very ancient School of Phyſicians, which was ſo much decay'd and forgot in the Time of *Hippocrates*, that he does not once mention it.

[9] *Cos* was the Iſland where the firſt School of the *Aſclepiads* was fixed; concerning which we ſhall be more particular in our Account of *Hippocrates*, §. 13 and 14.

[10] At *Epidaurus* we are told *Æſculapius* was born, where the Worſhip of that God was very ancient and famous, inaſmuch as the God himſelf frequently performed Miracles; but when a raging Peſtilence came to *Rome*, he fixed his Seat there. In

the Temple of this ſalutary God, the Sick, who came far and near, uſed to ſleep, and receive their divine Advice in Dreams. —— The State of Phyſic, as we have hitherto traced it, was wholly empirical; and this Period of it may be conſidered as its Infancy.

§. 8. The firſt Foundation of Phyſic (as yet empirical) was therefore raiſed, 1. By *accidental Diſcoveries* [1], made without any Deſign. 2. By natural *Inſtinct.* [2] And, 3. By unexpected or extraordinary *Events.* [3] Which were the firſt Sources of Empiriciſm, or ſimple Experience.

[1] Hereby we intend the Knowledge of unuſual Effects from ſeveral Cauſes, by ſome Variation, which the Mind could not diſcern to be ſufficient in the Agent. Thus Men found that cold Water, tho' the moſt harmleſs of any Drink, being drank when the Blood was in a heat, would cauſe a Pleuriſy, and even Death. And ſo the Inhabitants of *Cairo* found only by Experience, that when the *Nile* overflowed its Banks, on the ſame Day the Plague would decline and ceaſe.

[2] By *Inſtinct* we here underſtand thoſe auxiliary Means reſulting both from the automatic Motions of the Body (§. 4.) and the ſpontaneous Endeavours of the Mind (§. 5.): not indeed the Conſequence of human Reaſon, yet ſufficiently conſiderable, and not unworthy to be examin'd into.

[3] Theſe *Events* are Effects contrary to the received Opinions of Men; as if a Perſon in a Fever, who was ſtrictly forbidden all Garden Fruits, ſhould recover his Health by eating plenty of Grapes; or as if the Ancients having experienc'd the

the cold Air of Service in inflammatory Fevers, ſhould uſe the ſame with fatal Conſequence in a Pleuriſy.

§. 9. The Art thus imperfectly eſtabliſhed, was ſoon improved and enlarged. 1. By remembering the Succeſs of the Experiments which had been made in it (*per* §. 8.) 2. By regiſtering a Deſcription of the ſeveral Diſeaſes, the Remedies, and their Operations; which were engrav'd upon the Pillars, Tables, and Walls of the *Temples*[1]. And, 3. By expoſing the Sick in the public Markets and High-ways, in order for thoſe who paſſed by to examine them concerning their Diſorders; that if they had known any thing effectual in the like Diſtemper, they might acquaint them with it, and adviſe them the ſame; and hence aroſe Obſervation, deſignedly made to remark the Events of Medicines and Diſeaſes. And thus Empiriciſm, or the Practice of Phyſic by mere Obſervation, became more perfect from each of theſe Principles (§. 8, 9.) tho' as yet the Faculty could only diſtinguiſh the paſt and preſent Events. But the Art was alſo advanced, 4. by *Reaſoning*[2], from comparing the Events obſerved (*per* §. 8, 9.) with the preſent Circumſtances and conſequent Effects, which was termed Analogy.

[1] It was a laudable Cuſtom that obtain'd among the Ancients, for any one that eſcaped ſome imminent Danger, to record the Hiſtory of their Preſervation in the Temple dedicated to the Dei-

ty to whom ſuch Preſervation was thought owing; thus it was after eſcaping Shipwrecks, and recovering from Diſeaſes, that a Hiſtory of the Diſeaſe, the Advice, and Means of Cure, might be expreſſed to future Ages in a Table devoted to that Uſe. Theſe Tables were the firſt Books that contained any medical Preſcriptions, and Caſes, or Hiſtories of Diſeaſes. With Monuments of this kind were filled the Roof and Walls of the Temple at *Epidaurus*, Things certainly of more Uſe than the pompous Monuments and flattering Accounts of People which in theſe Ages make the Ornaments of our religious Buildings.

[a] When any Body paſſed by the Bed of a ſick Perſon expoſed in ſome publick Place for Advice, they aſked what his Diſorder was? the Anſwer might be probably, an acute Fever; the Paſſenger upon this recalling to mind whether himſelf or any Acquaintance had been ill, and cured of the like Diſeaſe by any Remedy, bleeding, *&c.* the like Means was then recommended to the Patient on his own Experience; and thus Analogy made another and more perfect kind of Practice in Medicine, which even the Empirics themſelves cannot practiſe without; for notwithſtanding they ſo much condemn Reaſoning in Phyſic, they ſecretly call in its Aſſiſtance.

§. 10. The Art in ſome meaſure thus (§. 9.) eſtabliſh'd, was further improved and perfected, (1.) By appointing certain Perſons as *Phyſicians* [1] for the Cure of only one or a whole Claſs of Diſeaſes. (2.) By thoſe Phyſicians taking exact Accounts or *Hiſtories of* the ſeveral *Caſes* [2] or Diſorders which came under their Care. And, (3.) By their accurately obſerving and

and deſcribing the ſeveral *Remedies* 3 applied, with their Operations and Uſes. — Phyſic being thus hereditary in but a few Families, and *engroſſed* 4 by a ſmall Number of Hands, eſpecially among the Prieſts, it brought them much Honour and Wealth, tho' the Art itſelf was by that means extremely cramp'd in its Advancement.

[1] Certain Prieſts were appointed by the common Laws among the *Egyptians* for the Practice of Phyſic, who had an Income for their Service at the Public Expence, and were confined in their Practice under particular Reſtrictions. As, (1.) That no one preſume to practiſe beyond the Bounds of the particular Diſeaſe or Claſs which had been made his Province, but that each profeſs and act only for the Cure of ſuch Diſorders as had been cuſtomary for his Family. That (2.) every Phyſician practiſe agreeable to the Books of *Hermes*, and not to act otherwiſe at his Peril; but to be under certain Penalties for male Practice. That (3.) no Phyſician preſume to excite Evacuations till the fourth Day of a Diſeaſe. That none but Glyſters and gentle Remedies be uſed before the third Day in Fevers, ſtrictly refraining from Vomits and Purges. That (4.) none but Phyſicians preſume to practiſe Medicine.—Thus Phyſic muſt have evidently received conſiderable Advances among this wiſe, rich, and flouriſhing People, who ſo ſtudiouſly endeavour'd to cultivate it.

[2] Great was the Accuracy and Induſtry of the Ancients in their medical Obſervations, or Accounts of Diſeaſes; they patiently and carefully remark'd not only the paſt and preſent Condition of the Diſeaſe, but alſo the Patient's Age, Sex, Ha-

bit; Strength, and Diet; yet ſo little were they addicted to Hypotheſes, precarious Reaſonings, and drawing Concluſions from their Obſervations, that *Hippocrates* reprehends them for Timidity in thoſe Reſpects.

[3] The Medicines of that Age were taken chiefly from Plants; in the gathering and preparing of which the Ancients were extremely induſtrious, as we may judge from the *Cratonic* Epiſtle of *Hippocrates*, where he very minutely points out the native Soil, Time of gathering, and Method of keeping Hellebore.

[4] The Prieſts, being covetous of Wealth and Reverence from the People, and in order to increaſe the Reſpect and Number of their Patients, concealed the Art under the Pomp of Superſtition and Fable; by theſe Means depriving the Public of its Benefits, they reſerv'd the Art as a Secret to themſelves and Families. —— Thus when *Iphiclus* aſk'd the Advice of *Melampus* for Impotency, after the ſpecious Apparatus of Sacrifices and Augury, he ordered him the Ruſt of a Knife that had been ſtuck into an Oak; by this formidable, but vain Shew of Religion, he endeavour'd to conceal that ſimple Preparation of Steel, which had been ſlowly diſſolved by the acid Juice of the Tree, and was certainly a moſt excellent corroborating Medicine. A military Captain, who had a ſpitting of Blood, beſought *Æſculapius* for a Remedy; the Prieſts, who were verſed in Phyſic, anſwer'd, inſtead of the God, "that he muſt take the Kernels of Pine-"Apples mixed with Honey," a very proper Medicine; by which he was cured.—Even *Hippocrates* himſelf bound his Pupils by an Oath not to divulge the Myſteries of their Profeſſion to the profane Commonality. But throughout the whole Univerſe Phyſic was originally practiſed by hardly any

any but the Prieſts; thus it was among the *Jews* and *Egyptians*; in the Iſland *Lemnos*, where the Prieſts of *Vulcan* practiſed Phyſic; among the *Indians*, whoſe Prieſts were diſtinguiſhed by the ancient Name of *Brachmans*; and laſtly, among the *French* and *Germans*, where they were called *Druids*.

§. 11. Add to theſe (§. 9. 10.) that (1.) the Inſpections of Carcaſes by Prieſts in their daily *Sacrifices* [1], (2.) the Cuſtom of *embalming* [2] and opening the Dead, (3.) the Inſpection of Wounds, happening in all Ages, and (4.) laſtly, the dreſſing of Carcaſes by the *Butcher* [3], each afforded ſome Knowledge of the anatomical Structure of ſound Bodies, as alſo of the immediate and abſtruſe Cauſes of Health, Sickneſs, and Death.

[1] Sacrificing was a religious Rite among the firſt of Mankind, as we learn from our Accounts of *Abel* and *Noah* in the ſacred Hiſtory; and from the very ancient, though fabulous Account, of the golden Age. But as no Sacrifice would make Atonement, or pleaſe the Deity, but ſuch as were made of Victims perfectly ſound, therefore the Prieſts were obliged to be ſollicitous in their Enquiry after the Signs of their perfect Health, and to learn what States of the Viſcera imported that the Animal was unſound, being to anſwer for the Succeſs or Miſcarriage of his Oblation from the morbid or healthy Appearance of their Fibres.

[2] The Cuſtom of *Embalming* is very ancient, even before the Time of *Joſeph*; in order to which they were obliged to open the Body, take out the Viſcera, and fill up their Spaces with a Compoſi-

tion

tion of Spices; but all this could hardly be done for many Ages together, without frequently detecting the latent Cauſes of the moſt ſevere Diſeaſes, as well as the Structure and Situation of the Parts; and hence the firſt Foundation of *practical Anatomy*.

[s] The Butcher diſſecting brute Animals, could not avoid ſeeing the natural State, Situation, Number, Figure, &c. of their Viſcera, and various Humours; but frequent and deſtructive War afforded Opportunities of diſcovering many of the Muſcles and larger Veſſels, with the Articulations of Bones, to the naked Eye in the yet living Subject; inſomuch that ſome have attempted to extract a Syſtem of Anatomy from *Homer*, who has in reality writ Hiſtories of Wounds ſkilfully and anatomically ſtated.

§. 12. And laſtly, the Art ſeems to have been in a manner compleated, (1.) By the Diſſection of *living Animals*[t] made with a philoſophical View, and an accurate Inſpection of human Bodies after they had been kill'd by ſome Diſeaſe. (2.) By taking a more exact Account of the Cauſes of Diſtempers, diſtinguiſhing their Stages into Beginning, Increaſe, Height, and Decreaſe, Terminations, Variations, and different Symptoms. (3.) By a more perfect Knowledge of Medicines, artfully chuſing, preparing, and applying them; having firſt obſerv'd their Strength and Operations.

[t] *Democritus*, being ſkill'd in the Learning of the *Egyptians* and *Phœnicians*, ſpent a long Life in Experiments, particularly in the Diſſection of Brutes,

Brutes, to diſcover the Cauſes and Seats of Diſeaſes. The living Diſſection of brute Animals alone afforded always the greateſt Advances to Phyſic; without this neither would *Herophilus* have diſcovered the lacteal Veſſels in Kids, *Euſtachius* and *Pecquet* their *Receptaculum Chyli*, and thoracic Duct in the Horſe and Dog; nor *Harvey* his celebrated Circulation of the Blood. But theſe Diſſections were made with a double View, one merely in the way of common Butchery; the other with a View to Philoſophy and Phyſic. *Democritus* ſeems alſo to have joined Mathematics with his phyſical Experiments, having wrote of Gravity, a Vacuum, and the Elements.

§. 13. At length *Hippocrates* [1], in the ſame Age with *Democritus*, being well ſkill'd in all theſe (§. 7. to 13.) particulars, and furniſh'd with numerous wiſe Obſervations of his own as well as of others, form'd the beſt of them into a *Greek* Syſtem of Phyſic; and was the firſt that truly deſerved the title of Phyſician: for being of incomparable Reaſon and ample Experience, ſupported by a ſound Philoſophy, he laid a juſt and rational Foundation of Phyſic for future Ages.

[1] *Hippocrates* was a Man of happy Genius and great Learning, verſed in the Philoſophy of *Democritus*, which was the pureſt of any Syſtem, being founded on three Principles, Atoms, Gravity, and a Vacuum; which have been in our Age again reſtored by the moſt ſolid Reaſonings of Sir *Iſaac Newton*. Being deſcended from the great *Æſculapius*, the medical Knowledge of his Anceſtors in a manner glow'd and improv'd in his Blood from the very

very Birth; he imbib'd the Learning of the School at *Cnidos* and of the *Egyptians* in his Travels; ſo wealthy, that he is ſaid to have ſent his Son *Theſſalus* with a Ship armed and freighted with Medicines as a Gift, to attend the *Athenian* Fleet in their Voyage to *Sicily*. He had under him a Claſs of young Phyſicians, who were employ'd in making Experiments; which, when communicated to *Hippocrates*, he ſhew'd the Uſe of them to Phyſic. In his Practice he ſucceeded beyond any Mortal, being requited with divine Honours for his Service in the Plague at *Athens* and *Theſſalia*. He was no inconſiderable Anatomiſt, tho' he did not publiſh his Writings on that Subject; for he learn'd the Structrure of human Bodies from a careful Diſſection of their Parts, and obſerved that the *Inteſtinum jejunum* was almoſt empty of Aliment. He was ſo well ſkill'd in Surgery, that the Merit of no one comes up to him. He ſeems to have been a Lover of the Mathematics, from the Letter to his Son *Theſſalus*. When he aſſerts Philoſophy to be uſeleſs with regard to Phyſic, he ſpeaks of moral Philoſophy, upon which alone the *Pythagorean* School was then employ'd. He made himſelf well acquainted with the Opinions of his preceding and contemporary Phyſicians, and was the firſt that by juſt Reaſoning joined the Theory to Practice in Phyſic. He has given us ſuch Hiſtories of Diſeaſes from his own Practice and Obſervation, illuſtrated with the Experiments of his Pupils, as may vie with the beſt of our Moderns; and eſpecially in acute Diſeaſes, as the Pleuriſy, Phrenſy, Quinſy, *&c.* he has been ſo ample, that his Succeſſors to this Day can add but little; to be ſatisfied in this, any Body may, like *Duretus*, compile an Index of the Particulars relating to one Diſeaſe interſperſed thro' the Writings of *Hippocrates*,

crates, and afterwards let them be compared with what is given us on the like Diſeaſe by other Authors. His Works have been reviſed by *Aretæus*, but more perfectly by *Galen*.

§. 14. This Work of *Hippocrates* continued improving among the *Aſclepiads*[1], and was afterwards digeſted into a more regular Method by *Aretæus*[2]; and being ſtill further improved at various times by ſeveral Artiſts in different Countries, it was brought into the School of *Alexandria*, and came at laſt into the Hands of *Galen*.

[1] The Deſcendants of *Æſculapius* preſerved the Doctrines of *Hippocrates* entire to the Time of *Tiberius* and *Galen*. The whole Family being thus bleſs'd with the rich Treaſure of Obſervations that had been made and left them by their Anceſtors, and being alſo furniſh'd each with their own Knowledge and Experiments, were by thoſe Means informed how to moderate Nature; to excite her Forces when languiſhing, and to reſtrain her Powers when too violent. They learn'd the Virtues of Medicines not from ſuperſtitious Writings, but from the real Facts and Experiments of many Ages.—Their Method of Practice was like what follows: they knew by Experience that a Pleuriſy accompany'd with particular Appearances in the Spittle, Reſpiration, Heat and Pain, uſually ended in a fatal Mortification within the Space of three Days; but they found it had been alſo obſerv'd by one of their Anceſtors, that a Patient in the ſame Caſe recover'd by profuſe bleeding from a Wound till he fainted, whereas others in the like Diſeaſe periſh'd at the ſame time; therefore imitating the Advice

Advice of Nature, they bled plentifully, and exhibited lenient, watery, and diluent Medicines; which Method they found to ſucceed the beſt in all acute or inflammatory Caſes. But they alſo learned by the Obſervations of their Anceſtors, that a Pleuriſy attended with a free Reſpiration, a thick Spittle, with little Particles of Blood, and other Circumſtances of Heat and Pain, imported that the Diſeaſe would terminate the firſt Day; in which Caſe they therefore left the Diſeaſe to Nature; for they had found bleeding under theſe Circumſtances to ſuppreſs the ſpitting, prolong the Diſeaſe, and render it more dangerous.

[a] Before *Aretæus* we ought to have given *Herophilus* and *Eraſiſtratus* their due Praiſe, as two ſkilful Improvers of Anatomy. *Herophilus* is even ſaid to have diſſected three hundred human Bodies, many of which, being criminals, were opened alive: No wonder then he ſhou'd perceive white Veins (*i. e.* the lacteals) in the Meſentery; which by the way, is an argument that the Anatomy of the *Greeks* was not ſo ſuperficial as many have imagined. *Eraſiſtratus* wiſely obſerved that an Inflammation happen'd whenever the Blood paſſed out of its proper Veſſels into thoſe which only convey Spirits, meaning the Lymphatics. But theſe curious Writings periſh'd in the Conflagration of the *Ptolæmæan* Library, which happen'd in the time of (the firſt or) *Julius Cæſar*. The Library was founded by King *Ptolemeus Philadelphus*, and was ſupported by the ſucceeding Kings in *Alexandria*, to which City the moſt ſkilful Men in all Arts were ſolicited at the public Charge. *Alexandria* was frequented by the Learned of every Nation, for the Promotion of Learning, and particularly Phyſic. From hence came *Galen:* And here *Attalus* King of *Pergamus* founded a Library, and made phyſical Experiments

ments of Poiſons on Criminals. But *Aretæus* of *Cappadocia* was the firſt who being ſkill'd in the Writings of *Hippocrates*, and other *Greek* Phyſicians, reduced Phyſic into a more regular Syſtem, and added what had been left upon the ſame Subject by other moſt eminent Phyſicians. After him, *Aſclepiades* of *Bithynia*, in order to advance his Fame, boaſted he had ſecret Medicines, by which he preſerv'd his Health, kept off Diſeaſes, and wou'd prolong Life: He alſo gloried in having reſtored a dead Woman to life, who ſeems to have been in an hyſteric Fit. Nor was the Notion of *Theſſalus* more vain, who contracted the Study of Phyſic to the Space of but ſix Months: Omitting the whole Phyſiology, he wou'd have the whole Care of a Phyſician conſiſt in knowing whether the Parts of the Body were too ſtrict or lax; to tighten them when too lax, and to relax them when too tenſe. But then the firſt of the *Latin* Phyſicians, *Celſus*, deliver'd the Doctrine of *Hippocrates* in his own Language with the greateſt Purity, and interſperſed many excellent Opinions of the other ancient Phyſicians. It is uncertain whether he, coming of a noble Family, learnt Phyſic only by reading; or whether he was employ'd in the Practice: tho' the latter ſeems moſt probable; at leaſt this is certain, that he was a Man of very great Learning, and has wrote of Phyſic with the greateſt Perſpicuity, and digeſted things into the moſt regular Method.

§. 15. *Galen* [1] made a Collection of their reſpective Writings, digeſted what was confuſed, and took a great deal of Pains to explain every thing *into the Clouds* [2], according to the Peripatetic Philoſophy; doing almoſt as much *harm to phyſic* by the one, *as he did it good* [3] by the other:

other: for by loading the Art with tedious Explications of every thing by the four Elements, the Cardinal Qualities, their ſeveral Degrees, and the four Humours, he has ſhewn much more Wit *than Truth in his Theory* [4].

[1] *Galen* was a moſt expert Logician, extremely well verſed in the peripatetic and natural Philoſophy, as he alſo was in the ſeveral Opinions of the Ancients: a Man of acute and fertile Genius, writing in a pure and elegant Stile; and in every reſpect truly a great Man. He lived about a hundred and ninety Years after the Birth of Chriſt, when *Severus* was Emperor.

[2] He confuſed every thing by ſtriving to make the genuine Obſervations of *Hippocrates* correſpond to the falſe Syſtem of the Peripatetics; and whenever he enquired after the Cauſe of any Appearance, he obſcured the Truths of the Divine old Man by his miſtaken Conjectures. He built upon the following Syſtem; "That Bodies are made up of "rude Matter, extended in threefold Dimenſions, "and endued with a ſubſtantial Form, which de- "termines and diſtinguiſhes the Body to be of this "or that Kind. That, among the ſenſible Affe- "ctions of Bodies, there are four radical or pri- "mary *Qualities:* Heat, Cold, Humidity and "Dryneſs; by which the Action of all Bodies is "to be explain'd, and from whence ariſe the pri- "mitive *Elements:* viz. Fire or hot and dry, Air "or hot and moiſt, Water or cold and moiſt, and "Earth or cold and dry. Which Qualities deter- "mine the Nature of all Bodies in which theſe "Elements exiſt. But that in the human Body "there are four primitive *Humours:* viz. Bile, an- "ſwering to fire, or hot and dry; Blood, cor- "reſponding to air, or hot and moiſt; Phlegm,

"akin

" akin to water, or cold and moiſt; and Melan-
" choly or Atrabilis, related to earth, or cold and
" dry. That out of theſe Humours, intermix'd,
" and retaining their elementary Qualities, ariſe
" *Temperaments* of People. That alſo theſe Qua-
" lities have different Degrees, not varying their
" Nature, but only differing as to more or leſs,
" intenſe or remiſs. Thus in Heat there are four
" *Degrees:* The firſt, which nouriſhes the natural
" Heat of the Body; the ſecond, which cauſes
" Fever; the third, which excites Inflammation;
" and the fourth, which cauſes Burning and Mor-
" tification. That this ſame Theory holds good
" with reſpect to the Virtues of Medicines, which
" have not only the ſame cardinal Qualities, but
" alſo a like Number of Degrees in each. Thus
" Medicines, which are potentially hot, if they
" are ſo in the firſt Degree, they reſtore the vital
" Heat of the human Body; if hot in the ſecond,
" they cauſe a Fever; if in the third, an Inflam-
" mation; and in the fourth, a Mortification.
" Therefore the chief Buſineſs of Phyſic conſiſts in
" our having a juſt Notion of the Qualities and
" their Degrees in Diſeaſes and Medicines. For
" when it was once found by us that the Cold in
" a quartan Fever aſcended to almoſt the fourth
" Degree, the natural Heat was then reduced to
" near one Degree and a third, and the Diſeaſe
" only wanted a Degree and a half of the greateſt
" Cold, by which means the cold Phlegm over-
" came the fiery Bile; it was therefore neceſſary
" here to give Medicines of a Degree and a third
" hot, in order to reſtore the healthy Tempera-
" ture, as Theriaca, *&c.* And thus in Preſcrip-
" tions, Opium, which is almoſt of the greateſt
" Cold, ſhou'd be corrected with Euphorbium,
" which has the greateſt Heat." —— Admirable

Skill, thus eaſily to eſtimate and proportion the Nature of Diſeaſes and Medicines, if it were not founded upon ſo weak a Baſis as a ſubtle but falſe Imagination.

[3] It muſt be acknowledged that Phyſic was made much more perfect on the Account of *Galen*, for as he was furniſh'd with almoſt all the Learning of the Ancients, he has reſerved to us many things of Conſequence which are no where elſe to be found: He was excellently ſkill'd in the Writings of *Hippocrates*, *Herophilus*, *Eraſiſtratus*, *Aſclepias*, with thoſe of the methodic and empirical Sects: His Merit appears from having accurately deſcribed Diſeaſes, Pulſes, and ſeveral uncommon Diſorders, from an occular Inſpection and a very ample Practice; beſides, he digeſted and reduced whatever Obſervations related to one Diſeaſe, and were interſperſed thro' a great Number of Books, to their general Heads, under one general Title; and by that means left us a very methodical Syſtem of Phyſic in all its Branches, containing almoſt every thing that had been diſcovered in that Age.

[4] The Theory of *Galen* was built entirely upon the Schemes of a fertile Imagination, and metaphyſical Subtilties, by which he and his Followers endeavour'd to account for the Appearances of Nature, who in a manner ſlipt thro' their Hands, in the ſearch, while they loſt themſelves in the Cloud. The Powers of Bodies which he aims to eſtabliſh are not in the leaſt ſufficient. Aqua-fortis acts not by heat, cold, or any other galenic Faculty, but merely by the Salts with which it is ſaturated. Alſo Mercury cures the Pox by Properties very remote from any comprized in the Claſſes of the galenic Scheme. His Degrees in Diſeaſes and Medicines are taken not from unerring Nature, but a precipitate and frantic Imagination; by which, in ſhort,

he

he did Phyſic more damage than all his Skill in the Ancients, many Years Practice, and Knowledge in the *Materia Medica*, cou'd ever repair.

§. 16. Learning after the ſixth Century being almoſt aboliſh'd in *Europe*, by its being overrun with barbarous Nations from the North (the *Goths*) who were quite rude in their Genius, Language and Manners, ſo as to *efface the Arts*[1] and almoſt the Memory of them; *from the ninth to the thirteenth Century*[2], Phyſic was nicely cultivated by the *Arabians* in *Aſia*, *Africa* and *Spain*; whereby Surgery in particular, with the *Materia Medica* and its Preparations grew more complete and correct: but then the falſe *Galenic* Theory. (§. 15. N. 2.) ſpread and peſter'd the Art more than ever; but this not without the Approbation of moſt of the ſucceeding Profeſſors: about that time they began to be inquiſitive after the Sciences in *Spain*, eſpecially in thoſe Parts next the *Saracens*, who expell'd the *Goths*; and there the firſt Reſtorers of Learning were ignorantly call'd *Magi* or Magicians, in the worſt Senſe of the Word. Here they began to expound the Writings of the *Arabian* Phyſicians, in public Academies; being as yet ignorant of, or at leaſt not accuſtomed to, thoſe of the *Greeks*. —— Even from the Time of *Galen* to the Beginning of the ſixteenth Century Phyſic receiv'd ſcarce any Advancement; for almoſt the whole Buſineſs of his ſucceeding Phyſicians, by which they were deſirous of Praiſe, was either to en-

large the Works of *Galen* with Commentaries, or contract them into Compendiums.

' Arts and Sciences have always ſhared equal Fate with the Deſtruction of Empires. The Learning of the eaſtern Nations had been long before aboliſh'd in like Manner. In *Egypt* the Arts and Sciences, particularly Phyſic, flouriſh'd under the firſt *Ptolemies*; but ſuffering by the Conflagration of a great Library (of 700,000 Volumes in *Alexandria*; ſix Hundred only of which were ſpared at the Requeſt and Clemency of *Areus* and *Auguſtus*) they languiſh'd to nothing, and their chief Profeſſors went over to *Rome*; by which means the Arts and Sciences were extinguiſh'd with the Strength of the Empire. But in the fifth Century after the Birth of Chriſt, a northern Storm of *Barbarians* ſpread thro' the more polite Part of the World; who extinguiſhed the ſmall Light of Learning that then remained. For being a furious People, and averſe to Science, of which they were ignorant, they burnt up the Libraries, together with the Univerſities and Cities: unhappy Age; when Men being only ſolicitous of animal Life, neglected the diſtinguiſhing Ornaments of Wiſdom. The *Roman* Language was firſt ruined by the *Longobards* that ſubdued *Italy*; and by intermixing and cementing it with foreign Words, they ſpread a Sea of Barbariſm throughout *Europe*. At length, in the ſeventh Century, *Mahomet*, an Enemy to polite Arts, eſtabliſh'd a new Religion upon his own Principles: in a little time he confirmed his Doctrines, both in *Paleſtine*, *Arabia*, *Egypt* and *Aſſyria*, preferring his own *Arabic* Language before the Sacred and Learned, and tranſlating every thing into that Language, began to revive the Arts and Learning of the *Greeks*. His Caliphs or Chief Prieſts travell'd

travell'd with Money and Authority over *Europe*, *Aſia* and *Africa*, in order to deſtroy the Language of others and eſtabliſh their own.

[2] In the ninth Century, *Spain*, where the Arts had taken Refuge, was ſubdued by the *Saracens* of *Africa*; who laying aſide their Victories for a comfortable Peace, and being a People naturally of ſome Genius, began by Degrees to ſearch in the learned Books of the *Greeks:* they then cloathed in *Arabic* the Writings of *Hippocrates*, *Ariſtotle* and *Galen*; in ſhort, the whole Nation was ſo enamored with the Beauty of Learning about the End of the tenth Century, that they erected a conſiderable Academy in *Morocco*, for the Education of Students at the publick Charge: they alſo collected a Library with ſo much Aſſiduity, that the King himſelf and the Chief Prieſt thought it not beneath them to lend a hand, and be preſent at their Exerciſes. At that time the *Arabians*, who were otherwiſe cunning and thoughtful People, ſo nicely dreſs'd up the *Galenic* Syſtem, that it prevail'd much upon the Minds of Men who were employ'd about mere Ideas, and ſatisfied with abſtract Notions. All Truth was ſought for in *Ariſtole*, and ſometimes in *Galen:* when any Author had ſhewn that his Opinions were agreeable to the Sentiment of either of theſe Fathers, they were allow'd to be true by univerſal Conſent.—They not at all meddled with Anatomy, nor made any great Progreſs in the Practice of Phyſic; they were indeed a little more curious in Botany and Surgery: but Chemiſtry, they either firſt brought into *Europe*, or, at leaſt, greatly improved it. They alſo added the Preparation of Medicines to Phyſic, inſomuch that the generality of Compoſitions ſtill retain their *Arabic* Names, Syrup from *Surep*, Juice; Julep from *Juleb*, Roſewater, *&c.* The Principal *Arabian* Phyſicians were

Rhaſes, *Avenzoar*, *Avicenna*, *Averhoes*; and, in Pharmacy, *Meſue*. The Fame of the *Arabians* thus promoting Phyſic at *Toledo* and *Corduba*, excited the Learned in moſt Parts of *Europe* to travel to that Part of *Spain* which was poſſeſſed by the *Moors*, to learn the Arts, and eſpecially Phyſic. Theſe *Arabians* bringing their Books into *Italy*, when there were hardly any other to be found there; the ignorant Populace every where vainly reckon'd them to be Magicians, as ſeeming to be learned beyond the Bounds of human Capacity.

§. 17. *At length* [1] they were confuted and corrected in their prejudiced and vain Notions by two Expedients; *viz.* by the Hippocratic Doctrine being reſtored and prevailing in *France* on the one hand, and by anatomical and chemical Experiments on the other. About the Year 1453 ſeveral *Greek* Manuſcripts were brought out of *Byſantia*, and tranſlated (by *Chryſoloras* [2], *Gaza*, *Agyropulus*, *Laſcaris*, *Chalcondulas*, *Trapezuntius*, *Myſurus*, and others) at *Venice*, and elſewhere; by which means the *Greek* Language and Authors were again reſtored to uſe. About the ſame time *Aldus* happily publiſh'd the *Greek* Phyſicians together by printing, which was then lately diſcovered. Alſo *chemical Experiments* [3] were ſoon after introduced, by *Arnoldus Villanovanus*, *Lully*, *Baſil Valentine* and *Paracelſus*; who applied Chemiſtry to Phyſic and Philoſophy: and then Anatomy revived; which was firſt cloſely proſecuted by the induſtry of *Jacobus Carpus* [4] in *Italy*.

About

[1] About these Times the *Spanish* Physicians, whose Nation by degrees recovered their own Country, corresponded and communicated in their Learning with the *Italians*; they began publickly to expound the Writings of the *Arabian* Physicians in an Academy at *Padua*; and in the beginning of the 13th Century they translated *Galen* into *Latin*.

Thus by degrees Barbarism began to be extinguish'd, but slowly; almost every Body being blinded and prejudic'd in favour of the Peripatetic Doctrine.

[2] During the whole fifteenth Century the unfortunate *Greeks* flying from their ruined Country into *Italy*, brought thither their Language, Books, and ancient Monuments, as their chief Treasure, and the Springs of true Learning; and in the 16th Century the Works of *Hippocrates* came into a general Esteem, being in a manner a new Book, since *Galen* only had been in use with the *Arabians*, and commented upon in *France*, where they had also translated *Avicen*. About the same time *Galen* arose more pure and entire, out of the vast Volumes of the *Arabian* Physicians, so as to be published by himself; then also the *Latin* Tongue began to recover its former Purity, and at the same time a new Desire inspired the Minds of Men after true and useful Knowledge; they now began to perceive that *Galen* was preferable to the *Arabians*, and *Hippocrates* still better than *Galen*; in the former of whose Writings *Fernelius* and *Duretus* were well versed, and being improv'd also by their own Experience, they dissipated the Esteem that had prevailed for the *Arabians*; and in this manner the rational or *Hippocratic* Practice of Physic was renew'd, and the salutary Art in a great measure restored to its pristine Splendor.

The firſt Chemiſtry appeared chiefly in the Monaſteries, where there were ſome idle People, Smatterers in Learning, who began to contrive in what manner they could make Gold. *Baſil Valentine* firſt applied Chemiſtry to Phyſic in the 14th Century; then flouriſhed *Paracelſus* at *Baſil*, who was a *Helvetian*, born in the Year 1494, about the Time of *Veſalius:* he being ignorant of the learned Writings of *Galen* and the *Arabian* Phyſicians, to which he had an utter Averſion, founded a new Sect of his own, which gained ſo much Authority in a few Years, that the Princes of *Germany* would hardly admit any to be their Phyſicians who were not Chemiſts. This Man raiſed his Fame chiefly by the Uſe of Mercury, in which Age only he and *Carpus* durſt venture upon the Exhibition of it, particularly in the Venereal Diſeaſe, which at that time raged exceſſively; ſo that as the Eſteem for the *Arabians* was overturned by the Doctrines of *Hippocrates* prevailing in *France*, in *Germany* the ſame *Arabian* Phyſicians were expunged by the Arms of *Paracelſus*. But in the beginning of the 17th Century there happened yet a greater Diviſion in the Schools and *Galenic* Doctrines than before. *Helmont* at that time, who was a Man of ſome Experience, of an acute and daring Genius, alſo verſed in the Opinions of *Galen* and the Philoſophers, as well as the Anatomy of *Veſalius*, quickly perceived that neither the Syſtem of *Paracelſus*, who was ignorant of Anatomy and Phyſic, nor the Verboſity and Controverſies of the Schools, would either of them direct to the Truth. But the Remedy which he applied was in effect worſe than the Diſeaſe, for he ſo founded Phyſic upon Chemiſtry, that he would have no other certain Way either to its Theory or Practice. After *Helmont*, *Sylvius de la Boe* firſt introduced Chemiſtry

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in the Univerſity at *Leyden*, and perſuaded the Stewards to build a publick Elaboratory for it. Chemiſtry is certainly a good Servant to Phyſic, but it makes as bad a Maſter.

[4] *Carpus* ſoon began to eſtabliſh Anatomy in *Italy* after his Return from Exile. The firſt that publiſh'd any thing upon Anatomy was *Mundinus*, in the Year 1450; after him *Jacobus Berengarius Carpenſis*, who firſt uſed Mercury in the Venereal Diſeaſe, by which he acquired much Wealth and Eſteem; he made a great Number of accurate Diſſections of Men and Brutes, publiſhing a Commentary upon *Mundinus*, and afterwards his own Anatomy, which being very ſcarce, I lately received from *Italy*, and peruſed with much Pleaſure in the Year 1731. But in the Year 1539 *Veſalius*, the great Reſtorer of Anatomy, began to write upon this Subject.

§. 18. At length the immortal *Harvey*[1], by the Diſcoveries which he demonſtrated, overturned the whole Theory of the Ancients, and founded Phyſic upon a new and more certain Baſis, upon which it at preſent reſts.

[1] He overturn'd the monſtrous and vain Hypotheſes which then prevailed in Phyſic, by publiſhing his incomparable Writings upon the Circulation of the Blood, and Generation of Animals; wherein "he demonſtrates the human Body to be "an Engine, all whoſe Offices depend upon the "Circulation of the Blood, which alone being "ſtopt, the whole muſt periſh;" from which Theſis alone the whole Theory of the *Galeniſts* and Chemiſts was overturn'd, and all the Learning of the Ancients; that only ſubſiſted which was founded and approved by Experiment; ſo that the whole Progreſs

Progreſs of Phyſic may be commodiouſly divided into the ancient before *Harvey*, and the modern after his Time; for he ſo happily managed his Diſcoveries and Opinions, that he ſeems to have gained the Conſent of almoſt all the Phyſicians before his Death; for *Hippocrates*, who was a careful Obſerver of Nature, being certain of the Cauſes, has alone left us the trueſt Accounts of her Appearances; nor is the Doctrine of *Harvey* contrary to that of *Hippocrates*, but rather an Explanation of it.

§. 19. Since his Time it has been variouſly improved, without *adhering to any*[1] particular *Sect*[2], not only by new and certain Diſcoveries in *Anatomy*[3], *Botany*[4] and *Chemiſtry*[5], but alſo by *phyſical*[6] and *mechanical*[7] *Experiments*, in Conjunction with the real Facts which have occurred in the Practice of Phyſic itſelf. From hence it appears that the Art of Phyſic was anciently eſtabliſhed (1.) by a faithful Collection of Facts obſerved, whoſe Effects were (2.) afterwards explained, and their *Cauſes*[8] aſſigned by the Aſſiſtance of Reaſon; the *firſt*[9] carries Conviction along with it, and is indiſputable; nothing being more certain than Demonſtration from Experience, but the *latter*[10] is more dubious and uncertain; ſince every Sect may explain the Cauſes of particular Effects upon different Hypotheſes. Tho' it is certain that Phyſic may be as well ſupported by juſt Reaſoning as by Obſervation and Experience.

[1] At preſent Phyſick may be learned without adhering to any particular Sect, by rejecting every thing

thing that is offered without Demonſtration, and by collecting and retaining only what has been offered and approved to be real Truth both by the Ancients and Moderns. *Hippocrates* adhered to no particular Sect, he propoſed nothing but what muſt neceſſarily be admitted by every one. An *Italian* Phyſician ſent me a little Book which he had, entitled, *Piccola de Arte Medica*; in this ſhort Compendium was compriſed whatever Propoſitions could be admitted for Axioms, or undoubted Facts by Phyſicians; I would adviſe you my Hearers, as much as poſſible, to the ſame Study; for you will find no other certain way of advancing in the Science.

[2] By this Term we underſtand a probable Opinion which has been receiv'd by many People, but yet is not ſo evident as to compel every reaſonable Perſon, ſkill'd in his Profeſſion, to allow it for true; but it is of the utmoſt Conſequence to diſtinguiſh what relates to the Sect or Opinion from Obſervation, or Matter of Fact. Towards the Height of an inflammatory Fever a burning Heat is felt throughout the Body; this is evident, and obſerved by every one; but *Galen* and his Followers tell us, that this Heat ariſes from Exceſs of Bile; the Chemiſts from a Redundancy of Sulphur in the Blood; *Helmont* from the Fury of an *Archeus*; all theſe Opinions are uncertain, and belong to each Sect; we ought therefore to reject them, to preſerve the Art ſecure and uncorrupted with falſe Conjectures, retaining only what reſults from Obſervation, or what follows of conſequence from the Facts or Obſervations, ſo evidently, that no ſkilful and unprejudic'd Perſon can refuſe their Aſſent. We have undoubted Experiments in Phyſics, Mechanics, Anatomy, Botany, Chemiſtry, and the Practice of Phyſic; all which we ought to admit

admit for true, ſo far as they are Experiments; nor are we to add any Suppoſitions or Conſequences, but what are deducible from them by ſevere and juſt Reaſoning. All the Facts and Experiments which the Anatomiſt perceives in the Diſſection of Bodies muſt be admitted for true; theſe are true in the Works of *Galen*, and will remain ſo in the Works of all ſucceeding Anatomiſts; but when we proceed to explain the Uſes of thoſe Parts, there is great room to err, as we frequently do. Chemiſtry teaches us the Changes which Bodies ſuffer of themſelves, and when applied to Fire; for Experiments themſelves teach no Falacy; but when we apply the Phænomena of one Body to account for the Appearances of another, and then draw Concluſions in reſpect to the human Body, we are frequently deceived. Thus if any ſhould ſay, that the fixed Salt of *Tachenius* is proper in the beginning of a Dropſy, his Aſſertion will be juſtified by Experience; but if he proceeds to explain the manner in which it operates, it is very poſſible he may be altogether deceiv'd. And thus in Botany, the Kinds and true Characteriſtics which have been imprinted on Plants from their Origin by the Creator, never ſuffer any Changes; but in their Virtues and arbitrary Characteriſtics given them by Men, they frequently vary and deceive us. Phyſics, which faithfully recounts to us the Appearances of Nature, juſtly deſerves our Reſpect and Attention; but in explaining their Cauſes it often ſtumbles; and being blinded by Hypotheſes, falls into the firſt Error which is neareſt: but mechanic Laws are eternally the ſame, and muſt remain perpetually true; tho' in our Application of them to Bodies not ſufficiently known, we are frequently deceiv'd. For Example in the Loadſtone, we know all Bodies gravitate or tend

to

to each other, this Law is univerſally true, nor is the Magnet excepted from it; but if one ſhould proceed to explain the Nature and Action of the Magnet by the Laws of Gravity, he will be altogether deceived, becauſe it poſſeſſes Properties diſtinct from any which reſult from Gravity; for if one Magnet be placed near another, and the lowermoſt at free liberty to fall in the Direction of the oppoſite Poles, it will not anſwer Expectation. The practical Phyſician aſſures us, that the Treatment of Diſeaſes which have the ſame Appearance with thoſe obſerved in the Time of *Hippocrates*, ſhould not differ from that uſed by him; but if the ſame Treatment ſhould be uſed in another Diſeaſe, differing or miſtaken by its Signs, or wrong Name, or uſed in an improper Stage of it, we can hardly expect to ſucceed; ſo that in this reſpect we ſeem to be more happy than our Anceſtors, in that not being ſeduced to Errors by any Authority, we only admit Facts, to which we are compell'd by the Force of Truth and free Conſent, or embrace ſuch Things only as are evinced by Experiments, or are ſo apparent from them, that we cannot confute their Evidence.

Literary Commerce has conduced much to the Improvement of Phyſic, when that was facilitated by the Inſtitution of public Poſts, or Conveyances of Letters; but much more by real Experiments, made by the Invention of various Machines, to lay the Truths of Nature more open to us; and laſtly, by the Inſtitution of learned Societies, for the Improvement of Philoſophy, natural Hiſtory, the Arts, and Phyſic, at *London* and *Paris*.

[3] There is no room to doubt in Anatomy, ſo far as it regards the Structure, Situation, and Connexion, *&c.* of the ſeveral Parts; but when a Phyſician adds to it the Uſes of thoſe Parts, the motion of

of their Fluids, *&c.* and endeavours to explain them upon too narrow Principles, he is in the utmoſt danger of Error.

[4] Botany has added much to the Perfection of Phyſic, it teaches us the characteriſtic Signs by which we are to diſtinguiſh one Plant from another; and has been ſo much improved within the two laſt Centuries, that if it was purſued with the ſame Vigour, there would be great room to hope for its arriving to Perfection in a ſhort time. *Micheley* and *Vaillant* have done Wonders in this Branch.

[5] Chemiſtry is the Obſervation of thoſe Changes which ariſe in different Bodies from the Application of certain degrees of Fire; ſo far as it exhibits Experiments, it may be certainly relied upon; but our Reaſonings in it are often fallacious; an Ounce of Antimony taken inwardly gently purges the Bowels, but when prepared by Fire, it occaſions the moſt violent Vomiting; the ſimple Appearance of theſe Effects is moſt certain, but the Explanation of them various and arbitrary. If any one remarks the Principles which are obtained from Blood applied to a certain degree of Fire, he will find there firſt aſcends Water, then Salt, and in the Retort remains an Earth *(per* §. 227.*)* Of theſe Facts one cannot be deceived; but if you ſhou'd by haſty Reaſon conclude from this Experiment, that the Blood therefore contains ſuch Salts and Oils as you thus obtain, it wou'd be an Error with a witneſs; if a Chemiſt takes upon him to account for the Appearances of Bodies, he forgets his own Character, and acts the Part of a Philoſopher, or too often, of a Rhetorician.

[6] One Part of Phyſics is experimental, declaring only the Appearances of Bodies obſerved by our Senſes; *v. g.* that Gold is the moſt heavy of Metals,

Metals, nineteen times heavier than Water, diſſolvable in Mercury, &c. and this Part of it cannot deceive a Perſon. The other Part of Phyſics is rational or theoretical, which by Reaſon accounts for the Properties of ſome Bodies by the Affections of others, which are capable of being made the Subject of our Senſes and Experiment; and in this latter one may be frequently and eaſily deceived. Nitre and Sulphur expoſed to the Fire, go off with a conſiderable Exploſion, this we are certain of; but that the Exploſion which happens in Thunder proceeds from the ſame Cauſe, we are not aſſured of, even we are ſatisfied to the contrary.

[7] Nothing is more evident than the general Rules which are deduced from mechanical Experiments; but nothing is more uncertain than what Mechanicians aſſert from thoſe general Rules concerning the human Body; they make phyſical and mechanical Experiments upon Bodies with a View to deduce general Rules from them, which Rules are ſuppoſed to be true in all Bodies ſubject to the ſame Experiments; thus we are told, that a Body falling from a given Height will acquire a certain Velocity; that the *Momentum* of the falling Body will be proportionable to the Quantity of Matter and Velocity, hence concluding that the Impetus of a ſolid Body falling upon another from a certain Height can admit of no Error in its Effects; but great Care ſhou'd be taken never to apply thoſe Rules to Bodies upon which the like Experiments have never been tried; a Rule of this kind may hold good in a thouſand Bodies, and yet be ſubject to an exception in the next; this haſty Preſumption has been the Cauſe of many Errors among many Mathematicians, who have applied their geometrical Propoſitions taken from Bodies of particular

[7] Diſpo-

Diſpoſitions to the human Body; for what is aſſerted concerning Veſſels of an indeterminate Reſiſtance, and of incompreſſible Fluids, which are not viſcid, is not equally true with regard to the flexible and elaſtic Veſſels, as alſo the compreſſible and viſcid Humours in the human Body; therefore they who think that all phyſical Appearances are to be explained mechanically, are in my Opinion miſled. I am even far from being of Opinion that thoſe general Laws which are inſufficient to explain the Appearances of ſimple Bodies, ſhou'd be capable of accounting for 'em in that which is of all the moſt compound, *viz.* the human Body.

8 The moſt conſiderable Genius's have been generally ſubject to this Fault, that they endeavour to obtain a Knowledge of all Things, *by detecting their Cauſes*; hence it happens, that being miſled by Experiments, they form general Concluſions, which are not practicable, or elſe inconſiderately conclude that Propoſitions deduced from a few Experiments will hold true throughout Bodies in general.

9 What is demonſtrated to us by our Senſes cannot be diſproved in any Age, nor oppoſed by any Authority, unleſs by that of the Scepticks. The Circulation of the Blood will be equally true and undeniable a thouſand Years hence as at the preſent Time. Such is the advancement of Phyſic in our Days, that if we continue our Diligence, its Copiouſneſs and Certainty muſt be indiſputable. There are indeed ſome who affirm Phyſic to be wholly conjectural, which is falſe; it has this in common with all other Arts, that it is imperfect, but that Imperfection is the Default of the Artiſt; which is generally greater in the Profeſſors of this, than of other Arts. Beſides, the Uncertainty of ſome things in Phyſic, do not diminiſh the Evidence of

other

other Propoſitions, of whoſe Certainty we are ſatisfied. *Hippocrates* tells us, that the Knowledge which is changeable is no Knowledge; we may be certain as to the Effects of Things; all the Difficulty lies in their Cauſes, in which we ſhall commit no Error, if we firſt conſider their Effects attentively, ſo as to deduce the Cauſe from them with Evidence.

10 The Conſequences which we deduce upon the trueſt Principles, often deceive us, and become ſubject to many Exceptions under different Circumſtances. It may ſeem ſtrange indeed to ſome, that the divine Reaſon of Mankind ſhould be ſo weak in real Facts, which are ſo obvious to our bare Senſes; but our Errors in that reſpect proceed not ſo much from the Weakneſs of our Reaſon as from our want of Thought, and too precipitate Judgment; the Ideas we obtain from Things are certainly true in themſelves, but we aſſign Cauſes from Effects too haſtily, before we have ſufficiently examined them. For Example, in Heat, the Ancients obſerved that a healthy human Body was always ſome degrees hotter than the temper of the ambient Air; that this Heat was continued from the very Birth, and then found that the Heart was the firſt Organ that acquired this Heat moſt, and the laſt that grew cold or retained it longeſt; it therefore ſeemed reaſonable to them, that the Cauſe of this Heat muſt reſide more immediately and conſtantly in the Heart; and that therefore the Heart muſt be as it were the Spring of all Heat in the human Body. All this they experienced to be true; but they ſucceeded very lamely in their Attempts to detect the Cauſes by theſe Facts; when neither the Nature of Heat nor the Action of the Heart were as yet diſcovered. They ought therefore to have poſtponed their Judgment till the ne-

ceſſary Data were aſſigned for this Affair, as we find it was in the Time of *Harvey:* they might then have learned, that in every Second of Time the Heart ejected two Ounces of Blood, with a briſk Force into the *Aorta*; and alſo, that it again received equal Quantities of Blood in the like Space of Time. But an Hour contains 3600 of thoſe ſmall Spaces of Time, and the natural Heat of a Man continues through all the Parts of his Body ſo long as the Heart continues to propel that Quantity of Blood into the *Aorta* in that Space of Time; if it abates the Number of its Contractions in the given Time, the Man muſt begin to grow cooler, and when it wholly ceaſes, his Body muſt become as cold as the Air. If they had conſidered theſe Circumſtances, they would have aſſigned the Cauſe and Seat of the Blood's Heat not to the Heart itſelf, but to the determinate Velocity with which the Blood moves through the Heart. But who would have ſuſpended their Judgment on this Affair, from the Time of *Hippocrates*, down to our Day; the Space of 2200 Years? that would have been declaring himſelf ignorant in one of the moſt conſiderable Articles of his Profeſſion; yet is it what ought to have been done; and with ſuch Patience only can Phyſic be purged from its Errors, and eſtabliſhed upon the moſt true and certain Principles. Therefore when a Difficulty of this Nature offers itſelf, not accountable for but upon Hypotheſes, we ſhould reſtrain our Judgment, and leave the Doubt to be ſolved by our Poſterity, when they ſhall have attained Light enough from Experiments which have eſcaped us. It therefore behoves us to defer our Opinions about the Uſe of the Spleen, and ſome other Parts in Anatomy, with the Virtues of many Plants, the Cauſes of contagious Diſeaſes from Poiſons, *&c.*

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till Time ſhall bring the Truth to Light. By this means Phyſic, 'tis true, will be reduced to a ſmall Compaſs; but then it will be true, certain, and always the ſame. But while, from the imperfect Ideas of many Experiments, we attempt to deduce Theorems, and eſtabliſh Opinions, it is impoſſible that Phyſic ſhould be free from Falacy and Errors: ſuch Speculations are fitter for the Lucubrations and Entertainment of the Learned, than to direct the Practice of a Phyſician, who being miſled by ſome ſuch ſpecious but falſe Theory in a City, might turn out to be of the moſt fatal Conſequence to its Inhabitants.

Of the Parts and Principles [1] *of* PHYSIC.

§. 20. FROM the ſecond Head (§. 19. (2.) Phyſic has been loaded with many *uſeleſs* [2] and *fallacious* [3] *Hypotheſes*; to *expel* [4] *which*, we are to conſider that the whole Deſign of the Art is to keep off and remove Pain, Sickneſs and Death, and therefore, to preſerve preſent and reſtore loſt Health; ſo that every thing neceſſary to be known by a Phyſician, is reducible to one of theſe two Heads.

[1] By *Principles* we here underſtand, not the conſtituent Parts or Elements of Bodies, but the Means of Demonſtration, or Truths; not depending upon others, but by which others are to be eſtabliſhed.

[2] Among the *uſeleſs* Hypotheſes, we may reckon that of the *Pythagoreans*, explaining the Nature of Bodies by Numbers; the ſubtil Matter of the *Carteſians*; a ſubtil and rambling *Æther*; the *Fuga Vacui*, &c. But the Ingenuity of Mankind has been generally unwilling to take up with ſuch Principles as are the moſt obvious to our Senſes, and uſeful to our Intereſt; they think we cannot underſtand Nutrition, unleſs we are firſt acquainted with the Nature of Wheat, nor can we underſtand the Nature of that, unleſs we are acquainted with the Nature of the conſtituent Principles. But their ſearch does even not terminate in the conſtituent Principles or Elements, but they muſt endeavour to find out by Conjecture in what manner the univerſal Matter of all Things does by a ſubſtantial Form put on the Texture and Diſpoſition of Wheat. But if theſe Things were poſſible to be known, as they certainly are not, they would have no manner of Uſe with regard to the Affairs of human Life.

[3] Such is the Nature of *fallacious* Hypotheſes, that when the Principles which are laid down for the Baſis are only imaginary, the whole Train of Conſequences which are thence deduced, muſt be evidently falſe, and amount to nothing. *Carteſius*, who contrived a philoſophical, but imaginary Hypotheſis, concerning the Structure of the World, founded upon the Laws of Motion, and a ſubtil Matter filling all Spaces, whirling about certain Axes, made the Parts of his Scheme correſpond ſo well with each other, that it was ſubject to little or no Objection, except the Falſity of its Principles. If in like manner ſome Geometrician ſhould attribute the Properties of a right-angled Triangle to an oblique angled-one, like the Theorem of *Pythagoras*, he might thence deduce a new Syſtem of Geometry, hanging very well together, but in reality no more

than a Dream; which, upon the removal of its Principles, muſt vaniſh into nothing.

[4] Every thing which does not conduce to the Preſervation of Health, and to the Cure of Diſeaſes, may be purpoſely omitted in Phyſic, notwithſtanding they may be both true and curious: becauſe a Phyſician may perform his Office without their Aſſiſtance. See my Oration relating to this Subject, *de repurganda Medicina.*

§. 21. The *Object* [1] therefore of Phyſic in the *Human Body* [2], is Life, Health, Diſeaſe, and *Death* [3], with the Cauſes from whence they ariſe, and the Means by which they are to be regulated, reſtored, or prevented.

[1] By the *Object* of Phyſic we here underſtand every thing which is abſolutely neceſſary to be known or done by a Phyſician; which, ſo far as it conſiſts in Contemplation of the Mind, is Theory; but ſo far as it relates to Action, it is, from the thing itſelf, called Practice.

[2] In the *human Body*, not as a metaphyſical Entity, not as a Mind, but as a living and animated Machine; for the Conſideration of the two firſt do not at all come under the Province of the Phyſician.

[3] Death deſerves to be conſidered by the Phyſician, both to avoid it, and to preſage it when unavoidable: it is prognoſticated to be at hand from the Symptoms obſerved in dying People; but the great Danger of a Perſon's Dying, can be only judged of from a previous Conſideration of the Nature of the fatal Accident. Suppoſe a large inacceſſible Artery to be punctured, though the Wound ſeems to be ever ſo ſlight and ſmall, yet it may be fatal, as we find by Experience, becauſe all the

Blood may be let out thereby till the Nerves of the Heart become paralytic. Fatal Events of this kind ought to be remarked, that we may be capable of judging in what Caſes our Aſſiſtance may be neceſſary, as in this to ſtop the Hæmorrhage.

§. 22. Phyſic is therefore the *Science* [1] or Knowledge of *thoſe things* [2], by whoſe Application and Effects Health may be preſerved when preſent, and reſtored when loſt, by the Cure of Diſeaſes.

[1] It has been much controverted among Phyſicians, whether Phyſic ought to be termed an Art or a Science. The Matter ſeems to be thus: Cogitation conſiſts of two Parts, Underſtanding and Will. Underſtanding or Senſe is by the Ancients diſtinguiſhed into five Degrees; the I. Firſt is ſimple Perception by our Senſes, thus we know Light and Sound exiſt, becauſe we hear and ſee. The II. Second is Science, or the Knowledge of Things by their Cauſes; as if one ſhould affirm it as a Rule, that hard Bodies upon Friction grow hot, and that therefore he may in this place aſſert that Heat will ariſe from the Friction of two hard Bodies together at this time, as they have done before. The III. Third is habitual Action or Art which produces thoſe things into Being, which were before formed by Science. Suppoſe, for Example, a Statuary, whoſe Mind is furniſhed with a requiſite Knowledge for the Formation of ſome Image: he retains in his Mind the Idea, we may ſuppoſe, of *Hercules*, to which the Block of Marble is to be carved, he knows what Parts are to be removed to diſcover the included *Hercules*, and he alſo knows how to uſe the Inſtruments by which the ſuperfluous Stone is to be ſeparated; this is the Science of

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a Statuary; but when the Sculptor himſelf comes, he examines the Piece of Marble, divides it into the Head, Trunk, and Limbs, and makes Cavities, which are to ſerve afterwards for the Throat, Eyes, *&c.* till at length by continually removing ſmall Parts of the Stone in this manner, the naked *Hercules* at length appears; all this is the Work of the Statuary, his Art or his Science put in practice. In like manner the theoretical Part of Phyſic may be termed a Science, but the Practice of it is to be ranked among the Arts. But there are other Reaſons why it ſhould be rather called a Science; firſt, *becauſe its Theory is put in Practice not by ſimple Imitation*, but by the Knowledge of Cauſes. Phyſicians not only know by Experience that warm thin Liquors abate Fevers, but they alſo underſtand that it does ſo, by relaxing the Fibres and diluting the viſcid Blood. But the Dyer is ignorant of the Reaſon why he adds Allum, Tin, or Gums, in his Art; as he alſo is of their Action. Secondly, becauſe Phyſic is a previous *Knowledge of Things to come.* We do not preſerve preſent Health, nor remove preſent Diſeaſes, that is not in the Power of Man; we only place Health again in the room of that which was juſt loſt, or in the room of the Diſeaſe which at preſent exiſts. I cannot be ſaid to cure a Pleuriſy on the third Day, nor is it in my Power; I only prevent the Diſeaſe from being conſtantly preſent, ſo as to turn to an *Empyema*, or Death. Nor can I be ſaid to preſerve preſent Health, but only to cauſe a Perſon to be in Health the next Day. IV. Fourthly, *Prudence*, or the Direction of Art with regard to future events, which chiefly relates to Things belonging to human Life. V. Fifthly, *Wiſdom*, which comprehends the four other Degrees.

[2] In like manner, as a Statuary ought to know the Inſtruments, and Methods of uſing them, to effect his Deſign, and then to judge what Parts of the Stone are to be removed to expoſe the Image to View; ſo a Phyſician ought not only to be acquainted with every kind of Remedy, and the Method of uſing the ſame, but he ought alſo to underſtand the Nature of Health and Diſeaſes, that he may judge what is to be removed of the Diſeaſe, that the loſt Health may be recovered.

§. 23. Therefore the Neceſſity, *Uſefulneſs* [1] and *Dignity* [2] of Phyſic, are hence ſufficiently apparent.

[1] The Service of Phyſic is evident from the Effects we daily find from the Practice of it; without it a great Part of Mankind would not live out their Days; and ſtill a larger Number of great Men being oppreſs'd with Pain and Diſeaſes, would ſpend their Lives uſeleſs to the Public. Some have indeed objected, that every Man may be his own Phyſician; but it will readily appear, that a Man employed in other Affairs, cannot be ſo perfectly acquainted with the neceſſary Doctrine of Phyſic, as thoſe who have made it the entire Buſineſs of their whole Life; nor is it poſſible they ſhould have the like Opportunities of learning Anatomy, Pharmacy, *&c.* And as for thoſe Reflections which are caſt with Contempt upon Phyſic by the Illiterate, they have aroſe from the Ignorance of ſome unſkilful Practitioners, and not from the deſerving Art itſelf.

[2] The Uſefulneſs of Phyſic in a Republick is both well known and eſteem'd, eſpecially as it is ſo extenſive as to touch the Life and Health of every individual Member; the Eſteem for it has always

always been so great, that People afflicted with Diseases had rather apply themselves to any ignorant Person than be without Physic; but it is very evident, that those who know any thing of Physic will not inconsiderately commit themselves to the Rashness of Pretenders. The most ancient Heroes, and even the bold *Achilles*, were not altogether unskill'd in Physic; nor did they think it beneath them to practise it with their own Hands. Our Saviour is a remarkable Instance in this respect, who being invested with divine Power, also made it his particular Care to relieve the bodily Disorders of Mankind.

§. 24. There are two Methods which may be relied upon as certain for the Attainment of our Profession, which may be esteemed its solid Foundations; the *First* is an accurate *Observation*[1] of all the Appearances offered to our Senses in the human Body, whether in *Health*[2], *Disease*[3], *Dying*[4], or already *Dead*[5]; whether they proceed from internal Causes residing in the Animal, or from the Action of external Bodies, Accidents, or the Art itself. The *Second* is a strict Consideration and Discovery of the several latent Causes, concealed from our naked *Senses*[6] in human Bodies, by a just *Reasoning*[7]; which is really necessary, to prevent future ill Accidents, and secure the good Events. Physic thus established upon Judgment and Observation, can be only attained by a just Reasoning from the several Facts, (1.) which have before been *thoroughly considered*[8] in every respect; from comparing those Reasonings

Reaſonings with Nature or Experience, and with each other; and from diligently remarking which of them appear agreeable or diſagreeable to Truth; that from the whole we may be enabled to draw juſt Concluſions in regard to preſent and future Events; which Concluſions may then be *relied upon* 9 with Certainty as Matter of Fact.

[1] Obſervation here is the Attention of the Mind to ſuch Changes as happen in human Bodies, all which Changes proceed from Motion, which Motion is produced originally in the Body, as a Machine; ſome of theſe Changes are obvious to the Senſes, others are not ſo; the Motion of our Fluids thro' their Veſſels does naturally eſcape the Notice of all our naked Senſes; therefore a Phyſician ought to be acquainted as well with the Objects which do not fall immediately under our Senſes, as with thoſe that do; for the Knowledge of the firſt is equally neceſſary to Phyſic with the laſt, tho' it be only attainable by Analogy, from comparing the Parts leſs known, with thoſe which are wholly obvious to our Senſes.

[2] The State of the Pulſe, and Reſpiration, the Colour, Heat, Tenſion, and Moiſture of the Skin, the Brightneſs of the Eyes, *&c.* as they appear in healthy Bodies, in order to diſtinguiſh the morbid Changes in the ſame Appearances; from a due Conſideration of all theſe Signs, may be deduc'd an Eſtimate of the Danger, or the Probability of Recovery, and State of the Powers of Life, or of the Diſeaſe; all which were largely conſider'd by the Ancients, but have undeſervedly been treated with much Neglect in the preſent Age.

By

[3] By enquiring into all the preſent Circumſtances of the Patient's Caſe, and by aſking him and his Attendants after every thing, which will not fall nnder his Cognizance without.

[4] *Hippocrates* was extremely well verſed in the Symptoms of dying People, and accurately remark'd the preſaging Signs of Death; but the ſucceeding Phyſicians have been very negligent herein. We indeed ſay a Man is dying when the Diſeaſe prevails and tends to Death; thus in a *Phrenitis*, which will prove fatal on the fourth Day, the Patient begins to die in the middle of the third Day, and the whole Syſtem of the Body, eſpecially the Brain, is gradually deſtroy'd.

[5] To ſearch out by practical Anatomy the latent Cauſes of Diſeaſes, of which we are often ſo greatly ignorant, and to remark all the Changes which have been made by Death throughout the whole Body, and all its Viſcera. Surprizing is the difference even in the external Appearance of the dead from the living Body; the engaging Livelineſs of the Eyes, and Purple Tincture of the Cheeks, which ſo allured our Fellow-Creatures but a few Days ago, do in this State vaniſh, and leave a ſtill, pale, and horrid Spectacle. But no leſs are alſo the Changes made by Death within the Body, inſomuch that *Ruyſch* taking the Hint from hence, has filled the Veſſels of dead Bodies by Injection, and reſtored again the lively Appearance which Death had deſtroy'd.

[6] An Inſtance of this we have in the *Sanctorian* Perſpiration, a Diſcovery of the utmoſt Conſequence in Phyſic, which that Author obſerved in his own Perſon, and has done more Service to Phyſic than all the ſubtil imaginary Schemes and Interpretations of *Galen*, which were made during the whole 13th Century. This Method of improving

ving Phyſic by ſenſible Obſervation, was follow'd by the *Cnidian* Phyſicians, who are on this account praiſed by *Hippocrates*, by whoſe own diligent Obſervations the Art of Phyſic in that Day was greatly perfected; he carefully remark'd every thing which happen'd in the diſeas'd human Body, whether from external or internal Cauſes; whether from the eating of *Wolfs-bane*, the Bite of a Viper, too large a Doſe of *Scammony*, ſudden Cold, and the like, *&c.* which have undeſervedly been much neglected by the Moderns. We ought to make it our chief Study to collect all the Obſervations and Experiments we poſſibly can, and diſpoſe them under their proper Heads; but an Experiment or Fact is with regard to the thing itſelf, an Appearance obvious to the Senſes of the Enquirer; our Mind adds nothing to the Appearance, but barely the Perception of it.

We are ſaid to reaſon when we compare the Ideas we have before experienc'd with each other, that we may be diſtinctly informed of every Property appertaining to each Idea, and thence form a Judgment of the Agreement or Difference between each; nor is there any thing more required to Knowledge, than this Compariſon diſtinctly and patiently proſecuted. But the Phyſician above all ſtands in need of juſt Reaſoning, to aſſiſt him in the Diſcovery in many things of the human Body, particularly the great Claſs of Diſeaſes which lie concealed from the Obſervation of naked Senſe; God has alſo given reaſonable Faculties to our Minds to make new Diſcoveries of Truth and Invention; we cannot expect ſuch Diſcoveries from careleſs Obſervation, and accidental Experiment, but from thoſe which are deſignedly made with a ſtrict Attention of Mind, to convert them to ſome Uſe. Obſervation or Experience alone will not make

make a Phyſician; for any two Diſeaſes are never ſo much alike, but a ſmall degree of Reaſoning may diſtinguiſh the difference.

[8] All the Obſervations which we have made upon any Head ought to be committed to Paper, examined with the ſtricteſt Attention, and applied to the preſent Circumſtances of our Patient's Caſe, that by conſidering every Particular, we may by a ſlow and ſolid Judgment determine the latent Cauſes of Diſeaſes. Take an Example of this; in the Method of detecting the latent Cauſes of Diſeaſes by external Appearances: we obſerve that in the living human Body there is a conſtant Reſpiration, in which the Air is alternately preſſed into, and expelled out of the Lungs; we alſo obſerve, that the inſpired Air is colder and dryer than the expired, which is warmer, and more humid; alſo that in Inſpiration the Air is forced through the Mouth and Noſe to the narrow Opening of the *Glottis*, thence into the wider Cavity of the *Larynx*, and from that into the round *Trachea* and conical *Bronchia*; and at laſt, from the Branches of the *Bronchia* into the ſmall Air Veſicles of *Malpighius*. In Inſpiration we know the *Diaphragm* becomes flat, and draws down the Ribs, by which means the *Thorax* is dilated, and the *Abdomen* compreſſed. In Expiration ſucceeds the Reverſe of all theſe; the Ribs return cloſer to each other, and the *Diaphragm* returns into the *Thorax*, of a concave Figure. In Inſpiration the Veſicles of the Lungs are dilated, the ſmall Veſſels ſpread upon them, variouſly agitated, opened, and the Blood more freely admitted into them; in Expiration the ſame Veſſels are compreſſed together, and their contained Blood ſtrongly propelled thro' them; for the Blood is forced from the Heart into the Lungs thro' a conical elaſtic Artery; but in a conical converging

verging Veſſel, every part of the contained Fluid ſtrikes againſt its ſides, which muſt therefore be dilated in proportion to the Force of the arterial Fluid; ſo that the Blood being expoſed to the Action of the Air in the Lungs, is forced into the larger Veſſels by the Contraction of the Heart, but into and thro' the ſmaller Veſſels by the compreſſing Force of the diſtended Veſicles, which is returned upon them; the Blood is therefore in the Lungs intimately mixed, greatly attenuated, and ſo fitted for circulating thro' the ſmalleſt Veſſels. This Doctrine of Reſpiration we ought to apply to the diſeaſed Patient, and compare it with the ſeveral Appearances or Symptoms preſent in the Body. Another Example of phyſical Reaſoning, extended beyond the ordinary Obſervation of our Senſes, may be given in the Pulſe, which is a latent Action, concealed from the Eye; yet notwithſtanding we may obtain a diſtinct and full Idea of it; *viz.* that the Artery is always full of Blood, and the Heart drives it forward with a conſiderable Force, are both demonſtrable from the Diſſection of living Brutes; but every Liquor, when it cannot proceed in its Courſe, reſiſts; therefore in the Arteries, which are full, their anterior Portion of Blood cannot return back, becauſe of the ſucceeding Blood, which ſtrikes againſt that which went before; therefore the preceding Blood not moving forward with the ſame Velocity with which the latter was propelled by the Heart, it muſt conſequently expand the conical Artery, ſo as to form the Pulſe; all which is equally certain with what is daily offered to our common Senſes.

[9] If Phyſicians were to unite their Endeavours, and form a Society for the collecting of every thing true and uſeful from the Writings we now poſſeſs, and afterwards digeſt them into Aphoriſms under proper

proper Heads, it muſt certainly form a Syſtem of Phyſic capable of ſolving any Difficulty in the Art with as equal Certainty as the Problems in any other Science.

§. 25. In order to diſcover Truth in this Manner by Obſervation and Reaſon, it is requiſite we ſhould fix on ſome Principles whoſe Certainty and Effects are *demonſtrable*[1] to our Senſes, which may ſerve to explain the *Phenomena*[2] of natural Bodies, and account for the Accidents that ariſe in them; ſuch only are thoſe which are purely material in the human Body, with *mechanical*[3] and phyſical Experiments; for we are not ſenſible of any other way of attaining to a true Knowledge of the univerſal and particular Affections of Bodies.

[1] Demonſtration is an evident Proof of ſome dubious Propoſition, ſo that no Body who admits the general Principles, can deny their Aſſent; theſe are pureſt in the Mathematics, tho' there are many Demonſtrations no leſs evident in Phyſic, eſpecially thoſe which are taken from Anatomy. But there is no neceſſity for the Principles of any Art to be proved in that Art, it is ſufficient if their Certainty is by any means demonſtrated in other Arts.

[2] Theſe ought to be firſt adjuſted with Diſtinction, Clearneſs, and Certainty; with Diſtinction, which points out one Being from any other; as if one was to define a Circle to be a right Line continued upon a Point till one End meets again with the other; with Clearneſs, which conſiſts of ſimple Notions or Ideas eaſily conceived by any Man in his Senſes, as that two and two joined make four; with

with Certainty, which cannot be denied by any reaſonable Perſon, or which muſt always appear true upon Examination.

[3] The univerſal Laws of Nature, or Affections of all Bodies, depend on mechanical and phyſical Principles, upon which alone their Actions are explicable; the ſame Laws are alſo true in the human Body, for its Matter appears to be univerſally the ſame with that of all other Bodies; ſo that what may be ſaid to be true of all Bodies, may be alſo affirm'd true in our own. Thus, if one ſhould affirm, that by the Friction of two Bodies would ariſe Heat, the ſame will be alſo true upon the Friction of ſolid Parts in the human Body. But then there are other Principles not to be explained by theſe univerſal Laws, but by ſome particular Diſpoſition in the certain Body; theſe Properties are called phyſical. But a Phyſician ought to conſider both the Affections of Bodies in general, as well as thoſe only proper to the human Body, that from a judicious Compariſon and juſt Reaſoning, he may never ſubject the human Body to thoſe Laws only, to which the generality, but not all Bodies, are liable.

§. 26. But as there are in the human Body many other *Appearances* [1] not intelligible upon thoſe Principles, they therefore are not to be demonſtrated and explained by ſuch Principles; if we would avoid Error, we muſt take a very different Courſe for that Purpoſe; this will readily appear to any one who conſiders and admits for true the following Propoſitions, which are elſewhere demonſtrated.

[1] Such as Memory, Underſtanding, Reaſon, and the Knowledge of paſt and future Appearances; which

which are peculiar to the Mind, a Being without Figure or Extenſion, and conſcious of Pleaſure and Pain.

§. 27. We are to conſider, (1.) That Man is compoſed of a *Body* [1] and *Mind* [2], *united* [3] to each other; (2.) that the *Nature* [4] of theſe are very different, and that therefore, (3.) each has a *Life* [5], *Actions* [6] and Affections differing from the other; yet (4.) that there is ſuch a reciprocal Connection and Conſent between the particular Thoughts and Affections of the Mind and the Body, that a Change in one always produces a Change in the other, and the reverſe; alſo, (5.) that the Mind performs ſome Actions by mere Thought, without any Effect upon the Body; and that it has other Thoughts, which ariſe barely from ſome Change in the Condition of the Body; on the other hand alſo, (6.) that there are ſome Actions performed by the Body without the Attention, Knowledge, or Deſire of the Mind, which is neither concerned therein as the Cauſe or Effect of thoſe Actions; that there are alſo ſome Ideas formed in the Mind of a Perſon in Health by its paſt Actions; and laſtly, that there are other Ideas compounded both of the paſt and preſent. That, (7.) whatever we obſerve to ariſe from Thought in the human Body, is to be only aſcribed to the Mind as the Cauſe. But, (8.) that every Appearance which has Solidity, Figure, or Motion, is to be aſcribed to the Body and its Motion for a Principle, and ought to be demonſtrated and explained by their Pro-

perties. That, (9.) we cannot underſtand or explain the Manner in which the Body and Mind reciprocally *act upon each other*[7] from any conſideration of their Nature ſeparate; we can only (10.) remark by Obſervation their Effects upon each other, without explaining them; and when any Difficulty or Appearance has been traced ſo far, that it only remains to explain the manner of their reciprocal Action, we are to ſuppoſe ſuch account *Satisfactory*[8], both becauſe it may be ſufficient for all the Purpoſes of the Phyſician, and as it is impoſſible for him to ſearch any further.

[1] By the Body we underſtand that Part of us which is extended in three Dimenſions, has a Form, and is fitted for Motion or Reſt, *&c.*

[2] By the Mind we underſtand that Being which thinks, and perceives itſelf thinking, and the thing thought of.

[3] The Union of the Body and Mind is ſuch, that the Mind cannot reſiſt forming to itſelf the Ideas of Pleaſure and Pain, when the Body is in a particular manner affected; nor can the healthy Body refuſe to obey the Action of the Mind under particular Circumſtances.

[4] By the Nature of the Body or Mind, we underſtand every thing which we are ſatisfied belong to each. The eſſential Nature of the Mind is to be conſcious, or to think; but to think of this and that particular thing, is accidental to it. The eſſential Nature of the Body is Extenſion and Reſiſtance. Theſe Attributes have nothing in common to each other, nor ought one to conclude from Similitude, that two Beings are reducible to one general Claſs. When I think of Extenſion, it does

does not infer any thing of Thought; and when I reflect upon Thought, I can perceive no Connexion of it with Extenſion; therefore the Idea of the Body has nothing in common with that of the Mind, and the reverſe. In the ſame manner, there is no Connexion between the common Ideas of Time, Sound, Gravity, Light, *&c.* *Socrates* made a proper Anſwer to *Crito*, when he was aſk'd in what Place he ſhould chuſe to be buried? *viz.* "You will not find *Socrates* when you prepare my "Tomb, nor ſhall I be ſenſible of what you then "do for me." Nor are there Reaſons wanting to prove from the preſent Condition of the Mind, that it may live hereafter without any Commerce with its Body. The incomparable Mathematician *Vietus*, who firſt reſtored Algebra to us, received the Enemies Letters from his King, to expound their myſtical Signs; while he was ſtudying to explain their Meaning, he was taken up with the moſt profound Meditation for three whole Days and Nights, inſomuch that he was not the leaſt ſenſible of what had been tranſacted without his Knowledge, taking no more Concern for his Body, than if it had been long deſerted as an Enemy by his Mind. In like manner, we find *Archimedes* in a Conſternation when he firſt was ordered to anſwer King *Hieronus* concerning the mix'd Gold in the Crown, till at laſt lighting upon the Experiment, *i. e.* going into the Bath, he cry'd out Victory. And in the ſame manner a *Roman*, who was in a deep Conſternation or Extaſy, being not at all terrified at the formidable Advances of the *Syracutians* in Battel, made a great Conqueſt without once breaking his Lines.

5 The Life of the Body is, 1. To generate Motion under particular Circumſtances, as the Loadſtone approaches to Iron. 2. For its conſtituent

Parts to attract each other, from whence proceeds that Reſiſtance to the Force of external Bodies, or *Vis inertia.* 3. To gravitate, or tend towards the Center of its Planet. And then, 4. comes the Affections proper to particular Bodies. The Life of the Mind is, 1. To perceive the Appearances of all external Objects, by the Changes they make in the Organs of Senſation. 2. To judge or compare the nature of two Ideas with each other, and then to deduce ſome Conſequence, as that they are of the ſame Kind, or different; as we conclude from our Notions of a Circle and Triangle, that a Triangle is not a Circle. 3. To will any thing. In a word, the Life of the Mind is, to be conſcious. Theſe are all the Functions of the Mind; for paſt Actions are uncertain, and they may be all referr'd to the ſingle Act of its Conſciouſneſs.

[6] The Action of the Body is to communicate Motion to other Bodies; the Paſſion of it is to receive ſome Change in itſelf from another Body or a Mind. The Action of the Mind is Volition, which every Body is acquainted with, but no one can explain. The Paſſions of the Mind are the Changes it receives from external Objects by the Senſes. Suppoſe the Mind to be thinking of a Circle, and in the interim a Cannon to go off, it will loſe the Idea of a Circle, and acquire that of Sound; this is the Sufferance of the Mind, becauſe it can neither retain the Idea of a Circle, nor reſiſt that of a Sound. There are alſo ſome Affections in the Mind different from the preceding, ſuch as violent Paſſions, or involuntary Commotions, which the Mind cannot reſiſt, and the Faculty by which it moves and determines the ſeveral Parts of a human Body, agreeable to its Inclination.

[7] We cannot underſtand why two Principles, which have no Agreement in Power, ſhould thus concur in the ſame Functions, tho' there have been three Hypotheſes framed to explain the Intercourſe of the Body and Mind; the firſt is, by the *phyſical Influx*, which ſuppoſes the Thing thought of, and the Thought itſelf, to be one and the ſame; which we ſhall hereafter demonſtrate to be abſurd, in as much as our Mind is ignorant of its own Nature. The ſecond is the Syſtem of *occaſional Cauſes*; and the third ſuppoſes a Harmony eſtabliſh'd by God, taking it for an infallible Rule, that determinate Actions of the Mind muſt be neceſſarily attended with correſponding Motions in the Body, and the contrary; and this laſt ſeems to be the trueſt Opinion, but it leaves us equally in the Dark with the other.

[8] If any Action is to be explain'd which is compounded both of the Faculties of the Mind as well as of the Body, ſuch as Walking, Pain, voluntary Reſpiration, *&c.* a juſt Account ought to be firſt given how far, and in what manner, the Body is concerned in the Action, and then alſo of the Mind; if this can be done, it is enough, without diving into the manner of Connexion between the different Actions; the Explication of the corporeal Actions appertains to the Phyſician, and thoſe of the Mind to the Philoſopher; but their Connexion can be explained by no Man. Heat may be conceiv'd to ariſe in Bodies without any relation to a thinking Mind, as Mill-ſtones grow hot in their grinding; but Motion is not explicable from the Affections of the Body, nor even from the Properties of the Mind, therefore Heat and Motion are not accountable from the Mind; and if you ſhould ſay that the voluntary Motions of the Muſcles proceed from the Act of Volition in the Mind,

you explain the thing not in the leaſt, becauſe there is nothing in the Idea of Motion which is alſo to be found in any Affection of the Mind. We call an Explanation of a thing the Demonſtration of Agreement or Relation between its own Properties and the ſame in another; but this is here not only impoſſible, but alſo quite uſeleſs to a Phyſician; for the great Buſineſs of a Phyſician is to be acquainted with the Means of reſtoring loſt Health, and no Cure can be effected by him, but through ſome Change made in the human Body by the Application of others; therefore this Search after the Connexion between the Body and Mind not appertaining to a Phyſician, is to be rejected, among thoſe (§. 20.) which are uſeleſs to the Art. The Phyſician, who cures Diſeaſes of the Body, is not ſollicitous about thoſe of the Mind; for when the firſt is ſet to rights, the latter will quickly return to its Office. Thus when the Eye is blinded with a Cataract, the Mind cannot perceive ſenſible Objects by it, the Aid of Phyſic is therefore call'd in to couch the Cataract, or depreſs the opake cryſtalline *Lens*; after which the Rays of Light finding a free Admiſſion to the *Retina*, the Mind will be ſenſible of viſible Objects by it; and thus the Buſineſs of Phyſic will be done without the Aſſiſtance of Optics. When a Perſon is in a *Delirium*, or Swoon, the Phyſician cannot recall the Mind, which has no relation to his Buſineſs; but by applying Vinegar, or other Volatiles to the Noſe, he can reſtore the ſick Machine to its former Motions, and then the Mind will alſo exhibit its former Actions, and this full as well as if he underſtood the manner of Connexion between the Actions of the Body and thoſe of the conſcious Mind.

§. 28. We

§. 28. We may alſo affirm, that the *primary phyſical Cauſes* [1], in what manner, and the ultimate *metaphyſical Cauſes* [2], for what End, the moſt general Appearances are in a determinate manner affected, are neither poſſible, uſeful, or neceſſary to be inveſtigated by a Phyſician; ſuch as the Origin of primitive and *ſeminal Forms* [3], of *Motion* [4], the *Elements* [5], &c.

[1] *Primary Cauſes* are thoſe productive of ſecondary ones; but we always meet with God in our Search after theſe, and this puts a Stop to our further Knowledge; for God is an infinite Being, and if we compare the whole Univerſe with him, it will be found almoſt nothing.—In our Search after *phyſical Cauſes*, we ſhould not be over ſollicitous to determine every thing in which Experiment will not aſſiſt us; for we never can be certain of the Truth of ſuch Diſcoveries, and if we were, it would be of little or no Uſe to Mankind; we are thus wholly ignorant of the Origin and Communication of Motion in Bodies; for Motion is no more eſſential to the Idea of Body, than a Circle is to that of the Mind. Let thoſe Philoſophers appear, who hold that an Aſſembly of Gods joined together to form the Univerſe, and explain by one ſimple and univerſal Experiment, why any Body in motion communicates part of its motion to the next which it touches; an ingenious Perſon would anſwer, God made it ſo. We ought therefore to reſt upon Experiment, and lay aſide uſeleſs Attempts to explain the moſt general Laws and Principles obſerved in Nature; taking Example by the wiſe Ignorance of the Chemiſts, who barely relating the Appearances offer'd to them, are not con-

cerned about the firſt Cauſe. *Barthol. Schwartz* having diſcovered the ſurpriſing Experiment of producing Thunder and Lightning, by the Application of Fire to a Powder made of Nitre, Sulphur, and Wood-coals, mix'd in a certain Proportion, never enquired into the Cauſe of that Phænomenon by which almoſt the whole Face of the habitable World has been chang'd. The Moderns have found, that two Grains of Gold diſſolved in three times as much *Aqua regia*, and precipitated with half that Quantity of Oil of Tartar *per deliquium*, forms a Powder, which applied to a certain degree of Fire, will blow up a hundred Weight. The Chemiſt ſtops at the bare Appearance; but the Philoſopher taking a Courſe very different from the Experiments of the Chemiſt, ſtudies the Formation of a mechanical Engine, by which two Grains will raiſe a Weight of a hundred Pounds; and thus each of them obtain their Ends by different Means.

[2] By metaphyſical Cauſes, are meant thoſe general Attributes of Beings which are abſtractedly eſſential to them as Beings; which are therefore very univerſal, and remote from Action.

[3] An Element is the Matter of which a Body is originally compoſed, and into which it may be ultimately reſolved. Great has been the Controverſy in all Ages about the Elements. Some contend for Water only, others for Air, and others again for Water and Fire; but the greater Number are for the four Peripatetic Elements; tho' the Chemiſts alſo build upon their Salt, Sulphur, and Mercury; but neither of theſe can be properly an Element, for it is eſſential to an Element to have its Parts abſolutely ſimple and homogeneous; but then how can Matter thus homogeneous form the great Variety of Bodies we meet with? If you retreat

treat to the *Monades*, or Atoms of *Pythagoras*, and univerſal Matter, you do not take our Eyes with you to convince us; nor can we be certain whether there are ſuch or no, ſince you tell us of things from which the Mind can never receive any real Ideas.

4 Some of the Chemiſts acknowledge beſides Matter, Form and Vacuum, a ſeminal Principle; which ſo determines the Structures of vegetable Bodies in their Growth, that they can appear in ſuch a particular Form, and no other. If an Aniſeed be ſowed in a pure Earth, moiſtened with Rain-water, and forwarded with a Heat equal to that of a ſetting Hen, it will produce the Plant Aniſe, whoſe Smell, Taſte, and Structure, differs from all other Plants in the Univerſe; and in the Vegetation of the Plant there is alſo a new Production of Seeds, each of which is capable, under proper Circumſtances, of producing the like Plant; if theſe Seeds were wanting, the whole united Power of Nature together could never produce the ſame Plant; therefore, according to the Opinion of the Chemiſts, this Seed muſt contain a Principle, which from Earth and Water always produces that particular Plant, which no other Seed can produce. In like manner they ſuppoſe Metals to to be formed of a ſeminal Subſtance, which grows or vegetates in the Bowels of the Earth with a ſubterraneous Heat, by means of a particular Juice; which Opinion is confirmed by philoſophical Experiments, and ſupported by many Reaſons.

5 The Origin of Motion is to be look'd for in God; if we ſubſtitute any other primary Cauſe, we do him Injuſtice. I may ſay that it becomes a true Philoſopher to confeſs his Ignorance of firſt Cauſes, which he is never likely to attain to; but notwithſtanding ſecondary Cauſes may be uſed to as

good

good Purpoſes as if we were acquainted with their firſt. If I learn by Experiment the Virtues of any Plant for the Cure of Diſeaſes, I may do as much Service with it in Phyſic as if I had created the Plant. If every thing uſeleſs to the Art was to be in this manner expunged, as we in this Section adviſe, Phyſic would loſe nine Parts out of ten, and be by that means purged of its Droſs, and reſtored to its native Simplicity.

§. 29. But a Phyſician may, and ought to furniſh himſelf with, and reaſon from, ſuch Things as are demonſtrated to be true in *Anatomy* [1], *Chemiſtry* [2] and *Mechanics* [3], with natural and experimental *Philoſophy* [4], provided he confines his Reaſoning within the Bounds of Truth and ſimple Experiment, *per* §. 25.

[1] He that deſires to learn Truth, ſhould teach himſelf by Facts and Experiments; by which means he will know more in a Year, than by abſtract Reaſoning in an Age. Proper Experiments have always Truth to defend them; alſo Reaſoning join'd with mathematical Evidence, and founded upon Experiment, will hold equally true; but ſhould it be true, without thoſe Supports it muſt be altogether uſeleſs. Nature diſtributes the Faculty of Reaſon to all Men equally alike, but he will excel in Reaſoning who has made the beſt Uſe of Experiments, having conſider'd the Structure, Situation, Figure, Size, and other Peculiarities, obvious to our Senſes in the ſeveral Parts of the human Body.

[2] Chemiſtry acquaints us with thoſe Changes which ariſe in Bodies from Mixture, and the Application of them to Fire. Suppoſe one Subſtance of

of a particular kind to be mix'd with another, and applied to a determinate degree of Fire, the Conſequence will be a Production of new Appearances, which is the Buſineſs of the Chemiſt to remark; nor does ever Chemiſtry deceive us, if it proceeds no farther than real Experiments, and their Effects; upon the Addition of the beſt Oil of Cloves to rectified Oil of Vitriol, they run into a violent Commotion, and exhale Clouds as thick as Pitch, which quickly turn into Flames.

3 Mechanics teach us to apply the general Laws of Motion to all Kinds of Bodies. Every Body is extended, reſiſts Motion, is moveable, capable of Form, *&c.* The Effects of all theſe general Qualities, and the moving Powers thence ariſing, are applicable to every particular Body; nor can we be deceived therein, if the Body to which they are applied be diſtinctly and carefully conſidered in all thoſe Reſpects. Mechanics therefore ſuppoſes a previous Knowledge of the Structure of all the Parts in the human Body, to which we would apply mechanical Laws; and in this Senſe Phyſic is no more than the Knowledge of ſuch Things as are tranſacted in the human Body, either by the common Affections of Bodies, or by the determinate and particular Structure of the Parts in the human Body. It therefore appears that Mechanicians, ignorant of the Structure of the Parts whoſe Actions they would expreſs by Numbers, muſt run into the Exceſſes of Error; which Defect has been charged upon ourſelves, for what has been formerly advanced in an Oration *de uſu Mechanices in Medicina*; tho' there are ſome, Enemies to the very Name of Mechanics, who aſſert, that our Bodies are not ſubject to the ſame Laws with all others.

§. 30. It is neceſſary for the Phyſician, in furniſhing himſelf with theſe Principles and Experiments, to begin firſt with ſuch as are moſt ſimple, certain, and eaſy to be underſtood; after which he may proceed to thoſe which are more compounded, and ſo by degrees to the moſt complex, obſcure, and difficult.

§. 31. He that would learn by Experiments, ought to proceed from Particulars to Generals; but the Method of inſtructing academically, proceeds from Generals to Particulars; which is the Method we ſhall obſerve.

A Profeſſor ſkilled in the Science which he teaches, firſt lays down general Rules, by which the Nature of each particular Subject is to be defined; but an Inventor of Diſcoveries ought to learn the Properties of every particular Body by proper Experiments, that he may afterwards reduce them into Claſſes, according to their Affinity: The firſt Method is in the Schools termed Analytical, the other Synthatical. The Inventor, *Ariſtotle*, when he obſerved that Oxen, who had Horns, wanted fore Teeth in the upper Jaw, and finding they were alſo wanting in Stags, Goats, Sheep, and other Animals with which he was acquainted, took occaſion to affirm, that all Animals that had Horns wanted upper Teeth. But *Ray*, teaching the Nature of Animals, lays this down for an Axiom, from which he infers, that neither the Ox, Stag, nor Range Deer, have Teeth in their upper Jaw becauſe they are horned.

§. 32. From theſe Conſiderations appears the Order of our Doctrine; for in the firſt Place we

we are to conſider [1] *Life*; then Health, afterwards Diſeaſes; and laſtly their ſeveral Remedies.

[1] Life is the Sum or Aggregate of all the Actions reſulting from the Structure of the ſeveral Parts in the human Body; when all thoſe Actions are performed with Eaſe and Perfection, it is called Health.

§. 33. Hence the firſt general Branch of Phyſic in our Inſtitutions is termed PHYSIOLOGY, or the Animal Oeconomy; demonſtrating the ſeveral Parts of the human Body, with their Mechaniſm and Actions; together with the Doctrine of Life, Health, and their ſeveral Effects, which reſult from the Mechaniſm and Actions of the Parts. The Objects of this Branch have been uſually denominated *Res naturales*, Things natural or according to Nature.

§. 34. The ſecond Branch of Phyſic is called PATHOLOGY, treating of Diſeaſes, their Differences, Cauſes and Effects, or Symptoms; by which the human Body is known to vary from its healthy State. This Branch is diſtinguiſhed into (1.) *Diagnoſtic* Pathology, ſo far as it deſcribes the Diſeaſes of the Body; (2.) *Ætiologic*, when it treats of their Cauſes; (3.) *Diacritic*, when it conſiders their Differences and future Events; and laſtly, (4.) the *Symptomatologic* Part of Pathology, is that which explains the various Effects or Symptoms of Diſeaſes.—The Objects hereof are termed *res*

contra

contra naturam, Things preter-natural, or contrary to Nature.

§. 35. The third Part of Phyſic is termed SEMIOTICA, which ſhews the *Signs* diſtinguiſhing between Sickneſs and Health, Diſeaſes, and their Cauſes in the human Body; it alſo imports the State and Degrees of Health and Diſeaſes, and preſages their future Events. The Objects of this Branch are the *Non-naturals* as well as the *Naturals* (§. 33.) and *Preter-naturals* (§. 34.)

§. 36. The fourth general Branch of Phyſic is termed HYGIENE, or *Prophylaxis*; which teaches us what Remedies are proper, and how they are to be uſed; to preſerve Life and preſent Health; and, as much as poſſible, to prevent Diſtempers. The chief Object hereof is the *Non-naturals*, or *Res non-naturales*.

§. 37. The fifth, and laſt Part of Phyſic, is called THERAPEUTICA; which inſtructs us in the Nature, Preparation, and Uſes of the *Materia Medica*; and the Methods of applying the ſame, in order to cure Diſeaſes and reſtore loſt Health. This Branch is called *Methodus Medendi*, ſo far as it Points out the Means and Cure; which are comprized under three Heads: (1.) *Pharmacy* [1], or the Preparation and internal Uſe of Medicines; (2.) *Dietetics* [2], or Regimen, reſpecting a Regulation of the Diet, Air, *&c.* And (3.) *Surgery* [3], comprehending manual Operation with Inſtruments, and topical Remedies.

By

[1] By the *Materia Medica* we here intend all Remedies, taken as well from Diet as Pharmacy; in which ample Signification *Dioſcorides* has deſcribed the *Materia Medica.*

[2] Natural Remedies, as they come firſt to our Hands, are very often unfit for the Stomach, too ſtrong in their Action, nauſeous to a Patient, or elſe not ſufficiently exalted in their Virtues. Phyſicians have therefore induſtriouſly contrived to render them more innocent, grateful, and efficacious, by ſubjecting them to various Preparations, Compoſitions, and Changes; and this is the Buſineſs of Pharmacy, whether Galenical or Chemical.

[3] The *Methodus Medendi* points out to us the curative Indications, with the Time and Method of applying Remedies, being the immediate Foundation of the extemperaneous Preſcription of Medicines, and of the general Rules to be given by the Phyſician for the Patient's Recovery.

§. 38. Having thus diſtributed Phyſic under its proper Heads, agreeable to the Nature of the Art itſelf, as well as the moſt convenient Method of teaching and learning the ſame, which is alſo approved by the eſtabliſhed Cuſtom of the Profeſſors through many Age paſt; we ſhall next proceed to treat of the ſeveral Branches ſeparately in that Order.

PHY-

PHYSIOLOGY.

§. 39. THE human Body, we find by Anatomy, is compoſed of *ſolid* and *fluid Parts*.

Fluids are thoſe Bodies which conſiſt of inſenſible Parts, having ſo ſmall a degree of Coheſion, that they eaſily ſeparate from each other, and give way to a ſmaller Force than will remove the whole Body; we ſay, conſiſting of inſenſible Parts, to diſtinguiſh them from a Heap of Sand, which might otherwiſe claim this Definition of a Fluid.

Solids are thoſe Bodies whoſe Parts cohere together ſo ſtrongly, that the whole is ſooner removed by any Force from its Place, than its Parts ſeparated from each other. There are various degrees of this Firmneſs or Solidity; thoſe animals Solids are the moſt firm which reſiſt Separation with the greateſt Force; ſuch as Tendons, ſome of which cannot be pulled aſunder by the force of two thouſand Weight; thoſe Parts are the leaſt ſolid which have ſo weak a Coheſion, that they may be ſeparated by a Force not much greater than what they ſuſtain in the healthy living Animal; ſuch as the cortical Part of the Brain. Thoſe Parts of the Animal are the moſt fluid which are ſeparated from each other with the leaſt Force, and are the moſt eaſily put in Motion; ſuch as the perſpirable Matter of *Sanctorius*; but thoſe are the leaſt fluid which are the moſt viſcid and ropy, ſuch as the *Mucus* of the Noſe, *&c.*

§. 40. The

§. 40. The ſolid Parts of the human Body are either membranous Pipes, or Veſſels including the Fluids, or elſe *Inſtruments* [1] made up of theſe, and more ſolid Fibres, ſo formed and connected, that each of them is capable of performing a particular Action by the Structure, whenever they ſhall be put in Motion; we find ſome of them reſemble *Pillars* [2], *Props* [3], *Croſs-Beams* [4], *Fences* [5], *Coverings* [6], ſome like *Axes* [7], *Wedges* [8], *Leavers* [9], and *Pullies* [10]; others like *Cords* [11], *Preſſes* [12], or *Bellows* [13]; and others again like *Sieves* [14], *Strainers* [15], *Pipes* [16], *Conduits* [17], and *Receivers* [18]; and the Faculty of performing various Motions by theſe Inſtruments, is called their *Functions* [19]; which are all performed by *mechanical Laws* [20], and by them only are intelligible.

[1] *Inſtruments* are compound Bodies, which by the Size, Figure, Connection and Diſpoſition of their Parts are capable of performing determinate Actions for particular Uſes. Thus the *Dentes Molares* are compoſed of the moſt compact and boney Matter, fit for dividing the more ſolid Aliments; Their Surface is rough and unequal, fit for holding faſt and grinding the Food; Their Articulation in the Sockets of the Jaws is the moſt firm, that they may not be looſened or pulled out in the Action; Their Size too is determinate, ſo as to be proportionable to their Office, and the Jaw in particular, as well as the human Body in general; all which Circumſtances concur to this effect; to wit, the Diviſion of hard, tough, and ſolid Aliments, by the rough Surfaces of thoſe Teeth. Several of theſe ſimple Inſtruments are uſually joined together into

one Organ, or compound Inſtrument, as Muſcles and Bones make up the Hand, *&c.*

[2] *Pillars* are perpendicular Supports, fixed upright under the Body which they ſuſtain.

[3] *Props*, are every thing which ſuſtains the whole, or ſome Parts of the Body, from receding out of their proper Places. Thus the Feet are the general Supports to the whole Body, the Veſſels to their contained Fluids, *&c.*

[4] *Croſs-Beams*, are Supports, whoſe Direction is parallel to the Horizon, or otherwiſe inclined, as the Ribs, Clavicles, and the digaſtrick Muſcles, with reſpect to the Tongue, *&c.*

[5] *Fences*, are hard, and reſiſting Parts, which keep off external Violence from the more tender Parts, which they defend: thus the *Cranium* is a Helmet to the Brain, the *Sternum* a Shield to the Heart and Lungs, *&c.*

[6] *Coverings*, are flat and flexible Fences, being tough as Leather, defending all the external Parts of the Body; ſo tough and hard is the Skin ſometimes found, that there are ſeveral Inſtances of Bones being broke by external Violence, without any Injury ſuſtained by that Part.

[7] *Axes*, are fixed Points, upon which Leavers turn to raiſe ſome Weights, ſuch as the *Trochanter major*, to the *Glutæi* Muſcles; the *Patella* to the extending Muſcles of the Leg, *&c.*

[8] *Wedges*, are ſharp edged or pointed Bodies, having ſeveral Sides, and a larger Baſis, fitted for cleaving and cutting hard Bodies aſunder; like the *Dentes Canini*, and *Inciſores*.

[9] A *Leaver* is an inflexible right Line, moving upon a fixed Point, to which it is faſtned; ſuch as all the long Bones.

[10] *Pullies*, are either moveable or immoveable Points, over which a Cord deſcends in an angular

Direction to raiſe ſome Weight; as in the Tendons of the digaſtrick Muſcles of the lower Jaw, and the *Trochleares* of the Eye.

11 *Cords*, are flexible Lines whereby Powers raiſe Weights to which they are faſtned; ſuch are the Tendons, Nerves, Muſcles, *&c.*

12 *Preſſes*, are inflexible Plains which approaching each other by incumbent Weights or Powers, preſs upon the intervenient Body; ſuch as the Heart, Stomach, *&c.*

13 *Bellows*, are Machines which take Fluids into a large Cavity, and expel them through a narrow Aperture; ſuch are the *Thorax* and Windpipe.

14 *Sieves*, are Plains perforated with many ſmall Holes, which only tranſmit ſuch Parts of Bodies as are leſs than the Diameter of thoſe Perforations, retaining and ſeparating thoſe Parts which are groſſer; ſuch as the ſmalleſt Blood Veſſels, with their lateral Lymphaticks, which exclude the red Part of the Blood, with the other Glands.

15 *Strainers*, or rather Filters, are Plains perforated with the moſt minute, but oblique Apertures, which tranſmit the thinneſt Part of Fluids, and keep back the more groſs; ſuch as the lacteal Veſſels in the Inteſtines.

16 *Pipes*, or Veſſels, are the Tubes diſtributed through every Part of the human Body, in which are contained their proper Fluids in Motion. There are three Kinds of theſe Veſſels, which keep their contained Fluids in a continual progreſſive Motion; Arteries, Veins, and the intermediate Veſſels which connect them; the two firſt being conical, and the laſt cylindrical.

17 *Conduits* are another kind of Veſſels, through which Liquors are conveyed, but not conſtantly, they being ſometimes empty, at other times full: ſuch as the Auricles and Ventricles of the Heart, *&c.*

the Figure of them is various, neither conical nor cylindrical.

18 A *Receptacle* is a hollow Body, which receives ſome Fluid, in which it continues for a certain time; the Bladder for Urine; Bile and *Semen* are conſiderable Receptacles; the *Folliculi Adipoſi*, are expanſions of the Extremities of the Arteries; the Pituitary *Sinus*, the ſimple Glands, and *Mucus Receptacles* of *Vaterus* in the *Uterus*, &c. whence it appears that there are many Fluids in the human Body which are not kept in a continual Circulation.

19 A *Function*, or Office, is the Power of acting, which depends upon the Structure of the Organ; but the Function put in Practice by Motion is the Action of the Organ.

20 If the ſeveral Parts of the human Body agree thus with the Structure of mechanical Inſtruments which we have juſt now enumerated, they muſt alſo neceſſarily act by the ſame Laws; for the Force of every one of thoſe Parts conſiſts in the Motion which they produce; and by whatever means that Motion is effected in the human Body, it is always performed agreeable to the general Laws of Mechanicks. There are indeed ſome who think that theſe Actions ought not to be explained by mechanick Laws, ſince the mechanical Cauſes of them are unknown to us; but in ſaying this, they ſhew very little Conſideration; for we are not treating of the Cauſes, but the Effects ſubject to mechanical Laws. There are many, and conſiderable Motions performed in Nature, of whoſe Cauſes we are ignorant; but the Motions themſelves are always ſubject to thoſe univerſal Laws which appear to be true in all ſenſible Bodies; even the Loadſtone, the Cauſe of whoſe Action is moſt concealed from us, performs its Motions by certain and known Laws; which once obſerved, never fails to be true when applied

to future Experiments. The human Body performs various Motions, the Cauſes of which are abſolutely concealed from us; but the Effects of thoſe Motions are the Elevation of Weights by fixed Cords, the Propulſion of Fluids through their ſeveral Veſſels, *&c.* which Effects being ſimilar to thoſe which are produced by mechanical Cauſes, are not governed by any other Laws.

§. 41. The fluid Parts of the human Body are included in their reſpective *Solids*[1], or Veſſels, by which they are kept in a conſtant and *determinate Motion*[2] or Circulation; being often *ſeparated*[3] from each other, *mixed*[4] together again, and variouſly *changed*[5] in different Parts of the Body, whoſe Veſſels and continuous Parts are *moved*[6] by them; the Sides of the Veſſels are *wore away*[7], changed in their Figure, and again renewed by them; all which Actions are performed agreeable to the *Laws*[8] or Principles of *Hygroſtatics*[9], *Hygraulics*[10], and *Mechanics*[11]; by which they ought therefore to be explained, yet ſo as to have a ſtrict regard to the *particular Nature*[12] or Texture of each Fluid; and upon theſe Principles alone depend entirely the Actions of each Part, ſo far as we are capable of knowing by all Kinds of Experiments.

[1] All the great Diſcoveries and Knowledge in theſe Parts which we now poſſeſs, is owing to the Induſtry of the Moderns; for the Ancients, tho' they were not ignorant that our Fluids had a Motion, yet they did not look for the Cauſe of that Motion in their Veſſels; nor were they at all curi-

ous in determining their Nature, Elaſticity, and conical Figure; but we are now ſenſible that the Fluids of the human Body exert no leſs Force to dilate their Veſſels, than their containing Veſſels do by their Contractions exert in order to drive them forwards.

[2] There is nothing in the arterial Blood itſelf which ſhould determine it to flow to Parts remote from the Heart, nor to make it return to the Heart in a contrary Direction; the Determination of that Motion is from the Heart.

[3] A Separation is again made of the different Liquors, which before apparently formed one ſimilar Fluid flowing thro' one Canal; after which Separation, thoſe different Liquors continue their Courſe apart thro' different Veſſels of their own; all this is perform'd in the Arteries: thus the *Aorta* receives the Blood, which was before intimately mix'd, from the pulmonary Vein, and diſtributes in ſuch a manner thro' the Body, that the ſanguiferous Arteries contain the red Blood, the Lymphatics its pellucid Part, the Veſſels of the ſalival Glands draw off their Fluid, the ſemeniferous Tubes the *Semen*; and ſo in the *Pancreas*, and other Parts, particular Fluids are convey'd off diſtinct from the Blood.

[4] The Fluids are ſo intimately mix'd again with each other, that there is no Part of one but may be found to contain ſome Part of the other; this Intermixture is performed chiefly in the larger Conveyances, as in the *Vena cava*, near the Heart, where all the Lymph, Chyle and Blood, returning from the ſeveral Parts of the Body, are pour'd into one Maſs; as alſo in the Sinus of the pulmonary Vein, the Sinus's of the Brain, and other venous Receptacles.

What

[5] What a Power the Vessels exert in changing the Condition of their included Fluids, is apparent in the Bile, which may be formed merely from Bread and Water; but how very different is the Nature of Bread from that of the Bile? and yet the Bread and Water suffer no other Action to convert them into Bile, but that of Mixture with the other Fluids already in the human Body, in Conjunction with the determinate Action of the Vessels in each Part.

[6] All the Motions in the human Body proceed primarily from the Fluids; the Bones are moved by the Muscles, the Muscles by their Nerves, and other Vessels, and these again by their contained Fluids.

[7] The Attrition suffer'd by the Sides of the Vessels from their Fluids, is in proportion to the Velocity of their motion; if the Blood in the Arteries is impell'd against their Sides with a double Velocity, they will be also repell'd again by them with a double Force. The Arteries in the cortical Part of the Brain, tho' so many times smaller than the Hairs on one's Head, do suffer an almost infinite Number of Shocks from the Force of Pulsation; they must of necessity be therefore continually ground away and impaired, and must consequently require continual Reparation by new Particles.

[8] Fluids are in general subject, I. To the same Laws and Affections which are demonstrated to obtain thro' all Bodies whatever. II. To those which hold true with respect to the Particles of solid Bodies; for the component Parts of Fluids are no other than solid Corpuscles. And, III. To those proper to themselves as Fluids.

[9] By *hygrostatic* Laws we mean those Affections of Fluids usually denominated hydrostatical, with-

out reſpect to any particular Qualities in Water, as the latter Term would ſeem to import. *Archimedes* going to treat of the Laws of Gravitation in Fluids, firſt of all propoſes four general Axioms. As,

I. That the whole Aggregate of the Fluid is perceptible by our Senſes.

II. But that no ſingle Particle of it is ſo to the naked Eye.

III. That the Particles and whole Aggregate of the Fluid gravitate.

IV. That their component Parts may be ſeparated by the leaſt Force.

From whence he deduces the general Laws, to which are ſubjected all the Fluids hitherto known, reſpecting barely their Fluidity, without regard to the determinating Properties of particular Fluids, or the Nature and Form of their containing Veſſels. Therefore as thoſe general Laws hold true of all Fluids, they may be alſo as juſtly applied to the Fluids of the human Body.

[10] *Hygraulics* is alſo rather uſed by us here than the received Name *Hydraulics*, becauſe we would not be underſtood to regard Water in particular, which does not include the ſeveral Properties of the Fluids in the human Body. Hygraulic Laws or Principles exhibit the Phænomena of Fluids moving thro' particular Veſſels or Tubes; but the Veſſels in the human Body are ſome of them *cylindrical*, giving no Reſiſtance or Change by their Figure to the motion of the Fluid; as in thoſe *Tubuli* which form the *Anaſtomoſes* of the evaneſcent Arteries with the incipient Veins; and others of them are *converging* and conical, where the Section or Diameter of the Tube is always leſſening, and the Reſiſtance of it continually increaſing, by which means alſo the Impulſe and Friction of the Fluid againſt

againſt the Sides of the Veſſel are perpetually augmented; while other Veſſels are *diverging*, where the Sections of the Tubes are continually enlarging, ſo as to diminiſh their Reſiſtances. The cylindric Veſſels in the human Body, are thoſe between the Arteries and Veins, the Perſpiracles of the Skin, *&c.* The conical converging Veſſels, are all the Arteries, and the *Vena Portæ*, after its Entrance in the Liver; and the diverging Veſſels are all the Veins and excretory Ducts.

11 That Fluids are alſo to be conſider'd mechanically, is apparent from their component Particles being Solids; therefore when the Parts of a Fluid perform any Action, they do it by the ſame Laws by which Solids act; and the Effects or Action of a Fluid is no more than the Sums of the Actions of their component ſolid Particles.

12 Were the Fluids of the human Body poſſeſs'd of no other Properties but ſuch as are in common to pure Water, and were its Veſſels metalline Tubes infinitely reſiſting, the forementioned Principles would then be of themſelves ſufficient to explain their Actions; but many of our Fluids contain elaſtic Globules, and all of them are compounded of Oil, Salt, Earth and Water, variouſly attracting and repelling each other; their containing Veſſels are alſo made up of elaſtic Fibres, admitting reciprocal Elongations and Contractions; therefore the Fluids in the human Body do not ſtrictly follow either hygraulic or hygroſtatic Laws, but they ſtray from thoſe Principles in proportion to the difference which obtains between them and common Water; nor are our Veſſels ſubject to the Laws laid down by *Herones* for Tubes infinitely reſiſting Fluids in motion; the Particles of the Blood are continually attracting each other, and run into Coheſions proportionable to their Contacts;

tacts; which is an Affection not common to all Fluids, but only peculiar to the Blood, and ſome others. In an intermitting Tertian the Patient becomes chill'd, and ſhakes or trembles with a continual Anguiſh or heavy Pain; in a while after he grows hot and feveriſh, and the Fit leaves him with a Sweat, and a lateritious Sediment in his Urine. In the ſame manner it will return again in 36 Hours time, and probably continue thus for ſeven Fits ſucceſſively, the Diſeaſe growing ſtill worſe and worſe at each Fit till the fourth, and from thence gradually diminiſhing to the ſeventh. The manifeſt Cauſe of all this Diſorder is apparently an Obſtruction in the ſmalleſt Veſſels; but no Mortal will ever explain all theſe Appearances by the Principles of Hygraulics and Hygroſtatics, becauſe they ariſe from a Change made in the conſtituent Particles of the Blood.

§. 42. By human *Life*[1] I would be here underſtood to mean in the common Senſe of the Word, that Condition of the ſeveral fluid and ſolid Parts of the Body, which is abſolutely neceſſary to maintain the mutual Commerce between that and the Mind to a *certain Degree*[2], ſo as to be not perfectly removed beyond the Power of being reſtored again. It would be inconſiſtent with my Deſign here, to give as yet a more ample Definition of Life; nor can I give a more clear Idea of Health, before we enter upon its Principles, than that at §. 1.

[1] Life cannot be defined well till its Phyſiology, or Nature and Principles of Action, have been firſt conſidered; for it is the Sum or Aggregate of all the

the Actions performed in the human Body; to give a particular Deſcription of which is the Buſineſs of Phyſiology.

[2] It is ſometimes no ſmall Difficulty for us to diſtinguiſh between a dead and living Body, as in People almoſt drown'd, in Syncopes, *&c.* where the moſt apparent Signs of Life are abſent. A young Nobleman, the only Son of a great Family in *Brabant*, being taken out of the Waters for drown'd, without any apparent Signs of Life, was thus cold and lifeleſs convey'd Home; in which manner he continued, as every Body imagined and reported, to be dead; but a Perſon ſkill'd in Nature had the apparently dead Body rolled upon a Caſk, and ordered Air to be blown up the *Anus* with a Pair of Bellows, continuing as it were to torture the Body till it had recovered an evident degree of Reſpiration and Senſe, and afterwards all the Faculties of Life, ſurviving the (otherwiſe) certain Death for many Years. —— The youngeſt Daughter of a *Dutchman* living in the Colonies of *America*, dy'd of an epidemical Fever; hereupon a Slave of *Angola* runs to the crying Mother, and promiſes he would quickly reſtore the dear Soul to life; then gather'd ſome very ſtrong Plants, which after chewing he ſpit up the Noſe of the Body, and opened its Mouth; and after repeating the Experiment ten times, the Patient recovered her Life; what Remains there could be of Life in that State is difficult to determine, tho' the Motion of the Heart, Blood, and Reſpiration, had all ceaſed, and according to the receiv'd Definition the Patient was really dead; but the *African* Slave thus vellicating the tender Nerves in the Noſe (of the Body not yet touch'd with Putrifaction) by the moſt ſtimulating vegetable Juices, ſo far agitated that which moves the Nerves, as to excite them to motion,

tion, make the Heart contract, and propel forwards its Blood. The Condition of the Girl now mentioned ſeems to be in a ſort of Medium between Life and Death. If by Life we mean a circular motion of the Fluids thro' the Heart, Lungs, and *Cerebellum*; and if by Death we underſtand ſuch a Diſſolution of the vital Organs, that they are quite irrecoverable, the mean State of theſe two will be a Stagnation, or abſolute Reſt of the Fluids, yet capable of being put in motion.

§. 43. But in order to obtain a juſt Knowledge of what is neceſſary to make (theſe, §. 42.) Life and Health preſent in the Body, we ought, (1.) to make an accurate Survey and Collection of the ſeveral Appearances to be met with in them both, (2.) to enquire into the *Subjects*[1] in which thoſe Appearances are ſeated, (3.) to inveſtigate the *Cauſes*[2] from whence they ariſe, (4.) the *Inſtruments*[3] by which they are performed, and, (5.) the Effects which they thus produce.

[1] For the Life of the Heart is very different from that of the Hair and Nails, nor can we underſtand Life as an Aggregate or Whole, till we have accurately ſurvey'd what it is in every ſingle Part of which the Body is compoſed.

[2] A *Cauſe* of any thing is a Being whoſe Exiſtence gives Being to ſome Effect or other, and upon whoſe Non-exiſtence that Being or Effect muſt alſo ceaſe to be; ſo long as the Heart continues its motion, ſo long does Life remain; but whenever that Organ ceaſes to move, Life itſelf alſo ceaſes to be; the Motion of the Heart is therefore the Cauſe of Life.

[3] *Inſtruments*

[3] *Inſtruments* are intermediate Cauſes, by which the firſt Cauſe produces its ultimate Effect. Suppoſe I have a mind to drive a Nail into the Wall with a Hammer, the firſt material Cauſe is a motion excited in the Body by the Influence of the Mind or Will, and the next is an increaſed Velocity or Influx of the nervous Fluid into the Muſcles, which firſt elevate, and then depreſs the Arm; the third Cauſe is the Hammer, of a determinate Figure, ſtriking the Nail; the ultimate Effect will therefore be motion in the Nail, by which it will penetrate into the Wall; the firſt Cauſe then is motion in the *Senſorium*, or Origin of the Nerves; the Inſtruments are the intermediate or ſecondary Cauſes between that and the ultimate, *viz.* the Nerves, Muſcles, and Hammer.

§. 44. But as theſe particulars (§. 43.) to be obſerved are almoſt infinite in Number and Variety, in order to learn or teach them methodically, we ought to range them under proper Heads and Claſſes, and then treat of each by itſelf in order.

§. 45. And firſt we ought to begin with thoſe Actions which are corporeal (*per* §. 30): but theſe are either, (1.) thoſe in common to both Sexes, or, (2.) proper to but one of them; the former of theſe are therefore to be conſidered firſt.

§. 46. The corporeal Actions in common to both Sexes may be next diſtinguiſhed into, (1.) thoſe performed by Adults, or, (2.) by the Fœtus and *incipient*[1] Animals; but of theſe again, the firſt is to be conſidered before the laſt, (*per* §. 30.)

[1] The

[1] The Order of Nature would direct us to begin our Hiſtory of the human Body where the Body itſelf begins to be formed; but that is repugnant to the Rule, which commands us to begin firſt with thoſe things which are the moſt obvious and eaſy to be known. The Mechaniſm and Nature of the firſt Rudiments of the human Body are entirely concealed from us; even the Knowledge we have of the Mechaniſm and Action of the ſeveral Veſſels and Viſcera in a *Fœtus*, is firſt taken from a Compariſon with thoſe of Adults; and where the Adult will reflect no Light by Analogy to the Nature of ſome Parts in the *Fœtus*, we are in a manner left in the Dark.

§. 47. But all theſe Particulars (§. 43, 44, 45, 46.) are link'd together in ſuch a manner, that by mutually performing the Office of Cauſes and Effects to each other, they ſeem to make a continued Circle without Beginning or End; which make it an almoſt inſuperable Difficulty to conſider them in a *juſt Order* [1], without any diſagreement to the Rules of good Method.

[1] An Enquirer after Truth ſhould adhere to the Rule of laying down nothing but what he has before demonſtrated in ſome preceding Propoſition; but whenever one begins to explain the Actions of the human Body, we ſhall always find there are ſome things neceſſary to be premiſed which are not as yet demonſtrated. The Heart is by every one acknowledged for the primary Machine, from whence the motion of the Blood and Life ariſe; but the Action of the Heart cannot be underſtood before the Nature and Action of a Muſcle has been explained,

explained, together with the Blood, and the nervous Fluid from the Brain and *Cerebellum*; but theſe Spirits again ariſe from the Blood, propell'd to the Brain by the Force of the Heart, whoſe Action we are inveſtigating; and thus our Enquiries may run in a Circle, without finding any beginning, where it will not be neceſſary to call in the Ideas of other Parts, in order to explain thoſe we firſt treat of. It is beautifully obſerved by *Hippocrates*, that "every thing in the human Body "is ſo diſpoſed in manner of a Circle, that you "will find the End where you would look for "the Beginning, and the Beginning where one "might expect the End." And *Pitcairn* affirms for a Truth, that one Part of the Body is not formed before the other, but that all the Viſcera were created and made at one and the ſame time; for all their Effects prove in the End to be the Cauſes of thoſe very Effects.

§. 48. Tho' of all Methods that ſeems to be the beſt, which Beginning with the *Aliments* at their firſt Aſſumption into the Body, proceeds to conſider the ſucceſſive Changes which they undergo in the ſame; not leaving them till formed into the ſolid and fluid Parts of the Body itſelf, and producing their ſeveral Actions: for as the whole Body is made up of thoſe Aliments, which we are capable of ſtrictly examining by our Senſes, and as its various Actions are alſo performed by their repeated ingeſtion, this muſt be apparently the moſt eaſy and certain Method of attaining to a Knowledge of the human Body.

[1] If the Law of Order or Method directs us to make our Beginning at the firſt Rudiments of the human Body, it even then ſeems moſt juſt to begin firſt with the Aliments; for what we receive primarily from our Parents, is ſo ſmall a Particle as to be imperceptible to us; whereas every Grain by which we exceed that Particle, ſo as to be enlarged to this ſenſible Bulk, is taken from the Aliments.

§. 49. The Aliments then, are either Solid or *Fluid*[1]; and therefore capable of being eat or drank. The Subſtances uſed for theſe Offices, were, in the firſt Ages of Mankind, only *Water*[2], and the natural Products of the *Earth*[3]; as we learn from ſacred and profane Hiſtory, as well as from the ancient Poets and the Nature of Things; but ſoon after, Men began to feed upon ſome of the *fluid*[4] and ſolid Parts of Animals, with thoſe of Fruits and eſculent Vegetables, variouſly prepared by Art.

[1] Something of *fluid* Aliment is often taken in from the ambient Air, abſorbed by the *Venæ inhalantiæ* of the Skin. *Paracelſus* even aſſerts that he ſaw a Man nouriſhed by means of Plaſters, which were applied to the *Hypochondria*.

[2] *Water* is the Principle from whence *Thales*, *Paracelſus*, *Helmont* and *Boyle*, deduce the Origin of all Bodies, whether animal or vegetable; and *Moſes* by divine Inſpiration aſſerts, that Fiſh and Fowl, which make a very great Part of the Animal Creation, were produced from this Element. We find the Uſe of Water as a Drink to be extremely ancient, both by the Conſent of profane as well as ſacred Hiſtory, and other Monuments of

of Antiquity. By ſacred Hiſtory we alſo learn, that *Noah*, and by the profane that *Bacchus*, were the firſt that introduced the drinking of Wine, both of them living a long time after the Creation of the World; but before their Times we may juſtly conclude that every Man was well contented with pure Water for his Drink, which makes the fluid Vehicle for nouriſhing and ſupporting the whole animal as well as vegetable Claſſes of the World. The drinking of Ale, whoſe Invention is by Antiquity aſcribed to *Oſiris*, was not cuſtomary for many Ages after *Noah*; and even in our own preſent Times, all the Drink we uſe is in a ſtrict Senſe nothing but Water; for if that Fluid receives any Addition by Art, it is rather to render it more agreeable to drink, than to make it a better Menſtruum to allay our Thirſt, and diſſolve the more ſolid Aliments.

[3] Before the Uſe of the Plough was invented, our Species liv'd entirely upon the Fruits of the Earth; and when that was contrived, they ſeem to have liv'd many Ages after without hunting the Cattle for Food, ſince they had no Weapons for that Purpoſe. The Creator favour'd our firſt Parents with eating of Garden Fruits only, but he afterwards indulged *Noah* with Fleſh of all Kinds; which Account is alſo agreeable to that of the golden Age, given us by the Poets; and *Pythagoras* alledges the Authorities of the moſt ancient Times, when he ſo ſtrictly commands Men to abſtain from Fleſh.

[4] Among the fluid Parts, we may reckon Milk and Eggs for the chief; the Uſe of which was even granted Men by *Pythagoras*, in Imitation of Nature, who had appointed Milk for the firſt Suſtinence of the new-born Infant, for which innocent Aliment ſhe has therefore given it a natural

Appetite by Inſtinct; for the firſt Action learned and practiſed by the new-born Infant is that of ſucking, and if the Nipple is denied it, the Finger is commonly put into the Mouth and ſuck'd inſtead of it.

§. 50. Even ſince thoſe early Times, *many People* [1] have been ſupported all their Lives with nothing but *Vegetables* [2] and Water; and what is more, whole Nations have been contented to live in that manner; a Man was formerly ſhow'd about for a Spectacle in theſe Parts, who lived upon nothing but Graſs and *Hay* [3]; while others have lived almoſt wholly upon *Fiſh* [4]; others barely upon *Fleſh* [5] and Milk; whilſt the Moderns ſpread their Tables with almoſt *every Kind* [6] of Vegetable, Fiſh, Fowl, and Quadruped; which Luxury of the Appetite is ſtill farther hightened by the various Artifices of Cookery, as the like Extravagance was formerly ſatirized among the *Romans*.

[1] The *Brachmans*, or moſt ancient Philoſophers, which were from their Habit called by the *Greeks Gynoſophiſts*, and who were particularly eſteemed in the Time of *Herodotus* for their Antiquity and ſtrict Morality, never admitted any thing but Vegetables, and ſome of the ſuperfluous Humours of Animals (as Milk, Eggs, Honey, *&c.*) to be their Food; but their Healths were not any ways impaired by that Courſe, their Lives were rather of the greateſt Extent, and their Minds fitted for Meditation, and the Culture of every thing curious and learned; even ſome of them, *Zoroaſter* and *Pythagoras*,

Pythagoras, are in a manner ſaid to be the firſt Starters of philoſophical Knowledge; and even the moſt devout Chriſtians of later Times, retreating into the ſandy Deſarts from the public Tyranny, have ſupported a long and healthy Life only by vegetable Roots, and other natural Products of the Earth, with ſimple Water, which they met with in their Walks.

[2] Many of the firſt Colonies of the ancient *Greeks* fed only upon Beech, or the eſculent Oak, which is alſo now brought over to furniſh the Tables of the Great in *Spain* and *Holland*. A very ingenious Gentleman accuſtomed to a very regular way of living in *Holland*, began to live wholly upon Graſs, but was obliged to deſiſt from it becauſe of a conſequent Diarrhæa, which yet was without any Danger, and is cuſtomary to the Cattle in Spring-time. And in this manner the *Perſian* Army, being fed only upon Herbs, ſuffered a very great Loſs of their Soldiers by violent Diarrhæas. All the maritime Ports of *Aſia*, from *Balſora* to the *Ganges*, for the Space of a Thouſand Miles in Length, were fed only upon Plants. The Religion of the *Bramines* was alſo received among thoſe Inhabitants. The very robuſt Natives of *Braſil*, who before the Approach of the *Europeans* often grew to the Height of ſeven Foot, and were no more decrepid at a Hundred than the *Europeans* at Seventy, lived upon nothing but the Grain *Mayz*, Sugar and Oranges; but now they are ſeduced both with the Cuſtoms and Diſeaſes of the Chriſtians.

[3] A Child being left in a Deſart by his Mother, was educated among the Sheep and Goats, by which means he learned to eat Graſs; and when he was taken, he would pick out thoſe from the ſeveral Plants brought him which were uſually

choſe by the Sheep; his Voice was like that of the bleating Cattle, being made a Shew to the common People in *Holland*. A noted Ruler in the States of *Holland*, famous thro' moſt Parts of *Europe*, took it into his Head to try upon how little a Man might live; he fed for ſeveral Months upon nothing but Peaſe, without any apparent Detriment from ſo unaccuſtomed a Diet, while the Table of his Family was all the time ſpread with regal Plenty.

[4] Such were the Countries of the *Ichthyophagi*, or Fiſh-eaters, mentioned by *Herodotus*, and the People who inhabited upon the Borders of *Æthiopia*; and in our Time the *Laplanders*, and other Inhabitants of the more northern Parts, make the Fiſh they have lately taken, ſerve them for Fleſh; and thoſe which have been dry'd, for Bread.

[5] The *Æthiopian* Nation deſpiſing Grain, liv'd wholly upon Fleſh and Milk, acquiring the Name of Long-livers, it being as cuſtomary for them to attain the Age of a Hundred and Twenty, as Seventy Years among us. The *Abyſinians*, their Poſterity, even to this Day live almoſt in the ſame manner; to whom *Lewis* XIV. ſent an Embaſſy, which was treacherouſly ſlaughter'd by the Multitude; along with the Embaſſy periſh'd *du Roule*, and *Auguſtus Lippius*, the latter of whom was a celebrated Botaniſt. God permitted our Species to eat the Fleſh of Animals ſoon after the Flood, but with this Reſtriction, that they ſhould not eat their Blood, in which was the Spirit of Life. It was formerly judged that the Soul of Brutes reſided in their Blood, for which reaſon it was not lawful to eat Blood; but God rather ſeems to have been unwilling that our Species ſhould eat the recent Parts and Juices of living Animals, that they might not become more fierce and perfidious by ſuch a Diet,

as now obtains among the People called *Anthropophagi*, or Man-eaters, whoſe Society and Manners are the moſt brutal and inhuman. And much in the ſame manner we find that Brutes who feed upon the Fleſh of other Animals alive, are the moſt fierce, miſchievous, and untractable.

[6] We *Europeans* daily make our Aliments of Water, Milk, and all Sorts of fermented Liquors; with every Kind of Fowl, Fiſh, and Quadruped, and an infinite Number of Vegetables and Pruſſe, variouſly mixed and prepared by Preſerving and Cooking, with Salt, Vinegar, Oil, *&c.* and yet Life is tolerably healthy, and long enough by a ſober Uſe of them: even the Learned *Bacon*, as well as *Celſus* before him, condemn a too ſevere and ſimple Diet, preferring a ſober and licentious Variation in our Food.

§. 51. So that by a proper Uſe of the ſeveral mentioned Aliments (§. 49, 50.) whether ſimple, *mixed together* [1], *crude* [2], or variouſly prepared, we find that the Life, Growth, *Nutrition* [3], and Procreation of Mankind, is principally ſupported and carried on. Nor does the different Nature of the Food make any *great Alteration* [4] in the *Subſtance* [5], or various Actions of the Body; the Parts and Organs of a human Body in Health have therefore the *Faculty* [6] of converting the various Aliments into a Matter ſimilar to their own, and fit for *augmenting or reſtoring* [7] ſuch Parts of the Body as are decay'd or conſumed.

[1] The Great Man which we lately mentioned (§. 50. N. 3.) to have lived only upon Peaſe, after he had acquired his Health by that means,

quickly returned to his accuſtomed Varieties, and that without any Impairment to his Health.

[2] A Gentleman of Learning delighted with the Proſpect of a ſtrong Camp in *France*, began to take a drawing of it, for which he was taken up as a Spy, confined in a ſubterraneous Priſon, and lived for ſeveral Months upon nothing but Horſe-beans and Water. He found for the firſt few Days, that this unaccuſtomed Diet diſagreed with him very much; but it became at length ſo natural to him, that he has often declared in Company, after he was ſet at Liberty, that he hardly ever enjoy'd better Health and Spirits than when he lived under Confinement upon that Diet. It is alſo a common thing for People to live many Years upon nothing but a Milk-diet, for fear of the Gout. And even I myſelf have lived a conſiderable Time upon the pooreſt Whey and Biſcuit, without the leaſt Prejudice to the Strength and Action of my digeſtive Organs.

[3] From ſo ſoft and fluid a Subſtance as Milk only, ariſe Bodies even ſo compact as the Bones, tough as the Tendons, and ſtrong as the Ligaments.

[4] It is a mere Fable, that the Drinkers of Wine loſe the Strength of their mental Faculties, by abſtaining from that Liquor; for I have known a wiſe Man, who was much addicted to Anger, live upon Whey only for the Space of ſix Months by my Directions. The Counſels which he gave during that thin Diet, were not in the leaſt inferior to his others. *Calanus*, the Gymoſophiſt, who lived only upon Wheat and Water, was inferior to none of the *Greeks*, either in Quickneſs of Underſtanding, or Sharpneſs of Wit.

[5] The Blood of a Man, who feeds upon almoſt every Kind of Aliment, and that of the Ox, who feeds upon Graſs only, is found to be almoſt direct-

ly

ly the ſame; and upon a chemical Analyſis, there is no ſenſible difference to be perceived; but by feeding too long upon Fiſh, the Blood of Animals has been known to contract an Odour like that of very ſtale Fiſh. Nor is this to be at all wondered at, ſince the vital Juices of Animals and thoſe of Vegetables, differ only one degree from each other; nor is there any greater difference between our Juices and thoſe of other Animals; even Plants themſelves are thus known to convert their Aliment into a Nature very different from its crude State; the Aloe makes its bitter Juices from the ſame Earth and Water as furniſh the moſt ſweet and aromatic Juices; and in this one ſingle Botanic Garden at *Leyden* are nouriſhed many thouſands of Plants by the Juice of one common Soil, which is afterwards converted into as many different Kinds of Liquors as there are Plants.

'There is an entire Renovation of all the Nails from their Roots in about ſix Weeks time, in ſuch People as cut them every Week for neatneſs. A broken Bone will be more ſtrongly united than before in leſs than the Space of two Months; and the Hair of the Head is wholly renewed in about four Months, as may appear from computing the Weight of Hair taken off at each time, inſomuch that the whole human Body is almoſt entirely changed in about ſix Months; and yet all theſe Maſſes of our Body, ſo often changed in our Life, are renewed and made out of our Aliments. But tho' theſe *exuviæ* differ in different Climates and Habits of Body, as do alſo the Aliments, yet the ſame Hair, Nails, Cuticle, and other Parts of the Body, are again made from the Aliment, notwithſtanding their different Nature, when the Organs exert their due Force, by which they aſſimilate the Aliments into a Subſtance like their own; but when that Force is ab-

ſent in them, the Aliment acquires a foreign Nature, and cauſes a Diſeaſe. *Hippocrates* obſerves, that the former Races of Mankind, who fed upon the crude Grain, were ſubject to many Diſeaſes, which are now avoided by preparing the Aliments.

[7] Suppoſe all the Parts of the Body to be in their healthy State, deprive them of Aliment, and the whole will ſhortly periſh; but allow them no more than the browneſt Bread and clean Water, and the ſeveral Parts of the Body will be as perfectly nouriſhed and renewed, as from eating the richeſt Varieties. There is therefore a certain Power in the human Body, which can change the Nature of Bread and Water into that animal Subſtance of the Body, from which it before ſo widely differed; which Power does alſo produce the ſeveral Fluids in the human Body, differing from Water, from the very ſame Aliments, in Conjunction with that univerſal Baſis of all Liquors. Nor could all the Powers in Nature by any means conſpire to make Blood, with the other fluid and ſolid Parts of the human Body, from theſe Aliments; if this Power, reſulting from the Texture and Actions of the Parts, was once abſent. The conjunct Action of all the Bodies in the World could never ſo much as form one human Tooth, from any or all of our Aliments, without that Power in the human Body itſelf, which converts the Subſtance of the ſeveral Aliments into that of the Teeth, and each other Part. This Power is often call'd *Nature*; being the aggregate Sum of all the Functions proper to the ſeveral Parts concerned in the Aſſimilation of the Aliment, or Converſion of them into the Nature and Subſtance of the ſeveral component Organs of the human Body.

§. 52. But

§. 52. But daily Obſervation and Experience informs us, that this Aſſimilation of the Aliment, may be performed with more or leſs Eaſe in the human Body; (1.) according to the different Nature of the ſolid and fluid Aliments in their crude State, and, (2.) according to the different artificial Preparation and Changes which they undergo, in order to facilitate that Aſſimilation of them afterwards in the Body.

§. 53. Therefore all Sorts of *ripe*[1] Corn or Bread Pulſe *(ærealia*[2]*)* after they have been dried, *cleanſed*[3], and *ground*[4], are firſt mix'd up with *Water*[5], then well *fermented*[6], and afterwards variouſly *cook'd*[7] by Fire; by which means they are much better fitted for continuing the ſeveral Actions, and renovating the ſeveral Parts of the healthy human Body. But the Parts of Animals we find by Experience are better fitted for the ſame Purpoſes, by variouſly *cleanſing*[8] and preparing their Parts by *beating*[9], expoſing to the *Air*[10], *pickling*[11], and drying, *boiling*[12], potting, *roaſting*[13], baking, or *frying*[14], &c.

[1] For before they are ripe they are very watery, flatulent, and afford but very little Nouriſhment.

[2] By this Name we comprehend all thoſe Plants which bear apetalous Flowers and farinaceous Seeds upon knotty and brittle Stalks, of which the principal are, Wheat, Barley, Spelt, Rye, Oats, Millet, Rice, Maiz, *&c.* Before Wheat was cultivated Men uſed Acorns in their ſtead. Among the ſeveral Sorts of Corn, Oats and Barley turn the ſooneſt

ſooneſt ſowr, which therefore afford the beſt Aliment in putrid Diſorders.

[3] Threſh'd and winnow'd from their Chaff, or common Integuments that defend the Grain from being injur'd by Inſects, which being hard and indigeſtible, ought not to be dreſs'd with the Meal; but tho' we juſtly ſeparate the Grain from its uſeleſs Chaff, we might as properly retain the Bran, or inmoſt Coat of the Grain, which would render the Bread more wholſome.

[4] That is, ground into coarſe Meal, or finer Flour; but even then it requires further Preparation to render it digeſtible. Horſes fed with the crude Paſte of Meal do indeed grow fat, but then they become weak and unactive.

[5] Water converts Meal into a moſt viſcid and ropy Paſte, which would of itſelf produce a *Leucophlegmatia*, or pituitary Swelling, Paleneſs and Weakneſs throughout the whole human Body; it is even ſcarce diſſolvable in Water, for Lads uſe Paſte as a Bait for their Hooks, to catch Fiſh with; it very quickly fattens Poultry, and other Cattle; but that Obeſity is morboſe, and often ſuffocates ſuch Fowls as have been thus cramm'd.

[6] Meal may be kept many Ages uncorrupted, if it be defended from Inſects, and the Moiſture of the Air; yet it is no ſooner mix'd with Water into an uniform and ductile Paſte, and ſurrounded with a warm Air, but the whole begins to ſwell, and acquire an inteſtine motion in its Parts; the Surface appears full of Eyes, or ſmall Holes, and exhales a ſtrong or ſoweriſh Odour; it alſo taſtes ſharp and acid, *&c.* and ſuch a State of it is call'd *Fermentation*; the Meal by that Operation loſes its glutinous Quality, becomes fryable, and more eaſily miſcible with Water. But Experience aſſures us, thoſe things digeſt the moſt eaſily which diſ-

ſolve

ſolve the moſt readily in Water, and thoſe the moſt difficultly which are leaſt apt to mix with that Fluid; hence fat Subſtances of all Kinds are very difficultly digeſted and aſſimilated. But as ſuch an acid Smell and Taſte is both unhealthy to the Body and unpleaſant to the Palate, the Fermentation ought therefore to be ſtopt before it arrives at that degree; and this is done with Fire, by baking the Dough into Bread.

[7] Baking frees the Dough from a great Part of its ſuperfluous Moiſture, and at the ſame time diſcharges the acido-areal Fumes of the Fermentation, which thereupon ceaſes; thus by degrees the Fire makes a hard Cruſt upon the Surface, raiſes the Bread, and renders it more dry, firm, and eatable. If it be bak'd a ſecond time in the like Heat, it is then call'd Biſcuit; which if kept free from Inſects, will keep ſound for Years in the very hot and moiſt Air under the Equator, where it corrodes Iron. Bread thus prepared eaſily diſſolves in Water, notwithſtanding its Hardneſs, without becoming glutinous, and is of all Breads by much the moſt wholſome.

[8] Cleanſed from their Impurities and Hairs, that the ſame might not happen in us as does to the wild Goats, who ſwallowing Hairs into their Stomachs, have them ſtuck together by glutinous Viſcidities, ſo as to form a hard Ball, being the Cauſe of many conſequent Diſorders, and even Death; alſo freeing them from their Blood, according to the Direction of *Moſes*; which is a moſt neceſſary Cuſtom in the hotter Countries, becauſe the Fleſh of thoſe Animals who retain their Blood, quickly putrifies.

[9] Beating of Fleſh always renders it the more tender, luſcious, and eaſy of Digeſtion; for the Juices are extravaſated out of the broken Veſſels, and

and diſtributed between the fleſhy Fibres. The ſame Effect has alſo hunting or chaſing the Animal with Dogs before it is kill'd; ſo that the Game which are this way taken, are generally much preferr'd to home-fed and kill'd Animals of the ſame Species, as being of a much higher Reliſh.

10 Keeping of Fleſh a moderate time in the Air alſo renders it the more tender, grateful to the Palate, and eaſy of Digeſtion; inſomuch that a Perſon may eat double the Quantity, without any Prejudice to his Stomach, that he could of freſh-kill'd Meat; for when the Juices of the Fleſh begin to ferment, and incline towards a Putrifaction, the Parts of the Humours become more volatile, their Salts more pungent, and the ſolid Fibres more tender; but the ſame Air, if it be cold, and agitated with ſtrong Winds, prohibits Putrifaction, and more eſpecially ſo when full of Smoke, which is replete with the volatile acid Salt of burning Wood, an utter Enemy to Putrifaction.

11 Meat is pickled with a Deſign either to preſerve it from Putrifaction, to give it a more agreeable Taſte, or to render it of more eaſy Digeſtion in the Stomach; the firſt Intention is anſwered by rubbing in common Salt, Nitre, Wine, Vinegar, and drying in the Wind or a Stove; the two latter Intentions are anſwered with Salts, Acids, Sweets, and Spices.

12 Fleſh boiled in Water communicates almoſt all its Virtue to the Broth, inſomuch that by changing the Water, and repeating the boiling, every thing which is agreeable to the Palate and nouriſhing to the Body may be extracted, ſo as to leave an inſipid and uſeleſs Skeleton. If this Broth be inſpiſſated it poſſeſſes all the Virtue of the Fleſh, and being diſtilled with an intenſe Fire, affords a larger Quantity of volatile Salt than the Fleſh, being

ing itſelf more ſapid, and ſubject to putrify in a ſhorter time; for the Fleſh may be kept in a temperate Air about three Days, but ſtrong Broths, and Gravy or Soops, begin to corrupt after they have ſtood but twelve Hours.

13 By roaſting we underſtand the dreſſing of Meat either by a naked Fire, or in a cloſe Veſſel, without any Addition of Water. Roaſting at a naked Fire forms a hard and brown Cruſt upon the Surface of the Fleſh, which keeps in the Juices ſtrongly agitated by the Fire, and by that means more ſtrongly tending to an alkaline State; the Fat becomes yellower, and more bitter, and the whole Joint of Meat is rendered more luſcious, dry, and eaſy of Digeſtion; the open Fire thus performs that Change upon the Salts and Juices of the Meat in a ſmall time, which a moderate Heat does in many Days; but the fuliginous Vapours of the Fire which adhere to roaſt and boil'd Meats, not only renders them diſagreeably black, but alſo in conjunction with the Change they make in the Meat, they very often produce inflammatory Fevers, eſpecially when eat in too great Quantities.

14 Frying is the dreſſing of Meat in a Pan over an open Fire with Butter or Oil; by this Method the Meat becomes of very bad Digeſtion to a weak Stomach, where it quickly turns rancid and alkaline; hence Meats thus dreſs'd are as bad as Poiſon to febrile Patients, and ought to make the leaſt Part of a ſalutary Diet; for the Fleſh this way dreſs'd ſuffers a much more violent Heat than that which is boil'd, ſince Oil requires ſix hundred degrees of Heat, by the Thermometer, to make it boil; whereas Water will boil with two hundred and twelve Degrees; ſo that the ſaline and oily Parts of the Meat are render'd ſo much more acrimonious by the intenſer Heat.

§. 54. The

§. 54. The Materials for *Sauces* [1] and Pickling, are chiefly *Salt* [2], *Vinegar* [3], *Oils* [4] and *Spices* [5].

[1] It now remains for us to ſpeak of thoſe Subſtances uſed for Sauces, to excite the Appetite, and promote Digeſtion, as well as to render our Aliments more agreeable to the Taſte. For theſe Purpoſes come in uſe Salts of all Kinds, of which ſome are acid, as Wine, Vinegar, Juice of Citrons, Lemons, *Sevile* Oranges, *&c.* Theſe being mild Acids, give an Appetite to weak Stomachs, and prevent that Rankneſs and Sickneſs which otherwiſe ſo frequently happens from oily and Fleſh Aliments; nor do they excite an Appetite by augmenting any Ferment of the Stomach; they rather promote Digeſtion, by preſerving the Aliment in a ſound State during its Diviſion in the Stomach. The Salts of a muriatic Kind, like the common, are both Enemies to Putrifaction, and Increaſers of the *Saliva* in the Mouth; being of ſuch conſiderable Uſe, that there are but few Nations who can do without them. Vinegar too is a volatile acid Salt, generated by a repeated Fermentation; its Acidity is both mild and grateful, not coagulating any of the animal Fluids (except Milk) whatever may be reported of it by the ignorant Populacy; but it dilutes and attenuates the Fluids, corrects and prevents Putrifaction in them, and in ſome degree ſtrengthens and conſtringes the ſolid Fibres. Spices and Aromatics, are ſuch vegetable Subſtances as exceed the reſt in the Strength and Agreeableneſs of their Smell and Taſte, joined with a pungent Warmneſs upon the Tongue; ſome of which are indigenous to *Europe*, notwithſtanding the generality of them are brought from the *Indies*. Thus our *Angelica* Root, *Acorus*, *Southern-wood*, &c. deſerve

deſerve as much the Name of Aromatics as Pepper and Ginger. Theſe Aromatics abound with a ſubtil Oil, in which is concealed the volatile Strength of the Vegetable as a Spice, termed by Chemiſts their *Spiritus rector.* By that Principle they wonderfully agitate the Nerves, and ſtimulate all the ſolid Parts to more large and frequent Vibrations or Contractions; for which reaſon they are ſaid to be hot; for by increaſing the Motion of the Solids, and their contained Fluids, they alſo produce Heat. If a Thermometer is inſerted into a Heap of Pepper, it ſhows not the leaſt Heat by any Aſcent; and if Pepper be applied to a dead Body, it does not in the leaſt make it warmer than before: but when taken into the living Body, by ſtimulating the ſolid Fibres, and augmenting the Contractions of the Veſſels, they increaſe the Motion of the Blood, which produces Heat. —— To theſe we may add every Kind of Pickles, which through the Luxury of our Appetites are every Year increaſing; and may all of them be reduced to ſome of the forementioned Claſſes, ſuch as the choice *Garum* of the *Romans*, a Pickle made of the ſtrongeſt Salt and the Liver of the Fiſh *Scombrus*, intimately diſſolved together; the *Ruſſian Caviaro*, made from the ſemiputrid Ovary of the Fiſh *Accipenſer*; the *French Botargue*, *Anchovies*, &c. the Strength of all which depends principally upon the Sea-ſalt.

[2] The Fleſh which would putrify in three Days time if left to itſelf, may be preſerved ſound for many Years, if it be frequently rubb'd with dry Bay-ſalt, or immerged in a ſtrong Brine made of the ſame Salt. Common Salt will alſo have the ſame Effect, as will alſo *Sal Gem*, *Sal Ammoniacum*, Salt-petre and Allum, except that the Allum communicates a diſagreeable Reliſh to the Meat.

[3] Vinegar,

[3] Vinegar, diluted with Water, made a very wholſome Drink amongſt the *Roman* Soldiers; they gave this to our Saviour at his Expiration, not out of Deriſion, but as being the firſt Drink at hand. Wine and Vinegar prevent the Putrifaction of Fleſh by their Acid; thus Brawn is preſerved in Wine.

[4] Oil or Butter preſerve Fleſh, by covering it, and excluding the Air and Inſects, ſo that it may be conveyed from *Britain* to the *Indies*, according to Mr. *Boyle*.

[5] Fleſh which is frequently rubb'd with Pepper and Ginger will not putrify, becauſe thoſe Spices keep out Inſects, and dry up the Moiſture.

§. 55. Garden *Fruits* [1] are indeed of ſo ſoft a Texture when full ripe, that they require little or no Preparation to render them digeſtible in the Stomach.

[1] Garden Fruits, which are reſtrained to their particular Seaſons of the Year, are all of them of a ſoft, pulpy Texture, and inclined to acid. When they are full ripe (which may be generally known by the Taſte of each, being the moſt perfect in their Kind, and in the Apple-kind, by the Blackneſs of their Seeds or Kernels) they are then of very eaſy Digeſtion; but they are all in general apt to breed Wind in the Bowels, which may however be much prevented by dreſſing them with Fire, or ſcooping ſuch as may be that way eaten, as Apples and Turnips in particular. An Apple which was placed in *Boyle*'s exhauſted Receiver, diſcharged twenty times its Quantity of elaſtic Air in the Space of twenty-four Hours; which Air is ſometimes found to be twice more heavy than that of our Atmoſphere. Therefore Garden Fruits muſt be unwholſome

wholſome to ſome by their Acidity and Flatulency, as they put on a State of Fermentation in the Stomach, eſpecially when eaten crude, and in very warm Weather. If the elaſtic Air which they thus generate in Fermentation finds a free exit either upwards or downwards, it is followed by no ill Conſequences; but if it is confined in the Stomach by a Stricture of its two Orifices, or even in the Bowels, it has been known to occaſion great Diſtention, excruciating Pain, violent Inflammation, and even Death. Nor are we without Inſtances of the fatal Effects of the ſuffocating Air ariſing from the Juices of Garden Fruits in their Fermentation, and burſting through the ſmall Crevices of their including Caſks. But when Fruits have once paſſed the Action of the Fire, which extricates their Air, they are then quite inoffenſive to the digeſtive Organs.

§. 56. As for Drink, the beſt is *pure running Water* [1], which may be drank *crude* [2]; but if it contains Inſects, their Eggs, or other foreign Bodies, it may be better fitted for Service, by filtrating through a Pumix or other porous Stone; alſo by gently *boiling* [3], and letting it ſtand to ſettle a while. But as to Drinks made by a *Decoction* [4] of Fruits or any Sort of Grain in Water, the Nature and Uſe of them may be eaſily underſtood; nor is the Compoſition and Uſe of Malt Liquors leſs known, particularly *Ale* [5], made by ſweating and drying the Corn in the Mow, cleanſing it from its Chaff, macerating in Water till it begins to vegetate, then by drying in a Kiln, grinding, and infuſing in ſcalding Water, then boiling, fermenting, and clarifying. The Formation

and Uſe of *Wines*[6] are alſo as equally intelligible; made by preſſing out the Juice of ripe Grapes, fermenting and refining the ſame.

[1] *Water* is the common Drink of all vegetating Bodies, the *Vinum Catholicum* of the Alchemiſts, without which they affirm nothing can grow and increaſe, whether it be animal, vegetable, or mineral. The pureſt Water is alſo found to be always the lighteſt, becauſe every foreign Body mixed with Water, as Sand, Earth, Minerals, *&c.* is heavier than the Water itſelf; upon which account the *Æthiopians* are ſaid to be long-liv'd, whoſe very light Waters would not ſuſtain a Piece of Wood. Rain-water is the pureſt, or moſt ſimple; not that which falls down in Showers thro' the Air, and becomes a Lixivium, by diſſolving all the volatile Salts, and other Bodies floating therein; but that which deſcends from the Clouds by the Attraction of the higheſt ſtony Mountains, thro' which the Water is ſtrained, and freed from every thing foreign, and then runs down in pure Streams thro' ſandy Currents towards the Foot of the Mountain.

[2] Pure Water is beſt drank crude; ſo that *Nero* did not act wiſely, when being ſick of every Sort of Wine, and exhauſted with the Fatigues of Luxury, at laſt drank Water, but after it had been firſt boiled in golden Veſſels.

[3] The Rain-water which deſcends thro' the Air in Showers, and is retained in Veſſels, is found to be replete with the inviſible Eggs of Inſects and Seeds of Plants; inſomuch that by letting it ſtand expoſed to the warm Air in a Glaſs Veſſel, you will quickly perceive it generate many Kinds of ſmall Weeds and minute Kinds of Animals; the ſame will alſo happen if you keep it ever ſo clean

in Glaſſes; but when once the Water has ſuffer'd boiling, then all the vegetating or prolific Power in the minute Ova of the Plants and Animals is deſtroy'd; yet more boiling than once will be prejudicial to the Water, the Water having ſome part of its Subſtance changed into a ſolid Sediment every time it is boiled.

[4] The Drinks thus made by a Decoction, partake of the Nature of the unfermented Maſs (at §. 53. N.) before mentioned, being aceſſent and very flatulent; which latter Inconvenience obtaining much in the Decoction of Barley, made *Galen* prepare a Decoction of Bread to it, in whoſe previous Fermentation the flatulent Parts had been exhaled.

[5] Ale, or the Wine of Corn, is ſaid to be the Invention of *Oſiris*, who travelling round the World, taught thoſe People whoſe Countries bore Vines, the Art of making Wine from their Fruit; and inſtructed the more cold and depreſſed Countries in the way of making Ale, which differs not greatly from Wine, by malting and brewing their Corn. And the Uſe of Ale is certainly of very great Antiquity among the *Germans*. The Method of malting and brewing Corn for this Liquor is thus: Any Sort of Corn, as Barley, being freed from its Chaff and Stubble, is infuſed whole in hot Water till it begins to ſwell; the Grain is then freed from its Water, and flung into Heaps, where it is ſuffer'd to lie till it ferments and grows ſo hot as to be ſcarce tolerable to the Hand, continuing thus till every Grain begins to grow or thruſt forth its Blade; but to prevent the Vegetation from going any farther, the Heap is ſpread abroad to dry, and is afterwards further dry'd, or ſlightly roaſted over the Fire in a Kiln; after which it takes the Name of *Malt*. The Grain thus treated becomes

ſweet and glutinous, eaſily communicating its Virtues to Water; the ground Malt is therefore caſt into ſcalding Water, and all its fine, mealy and ſaccharine Part is by that means extracted. If this Tincture of the Malt is boiled, inſpiſſated, decanted off clear, and then drank, it does not inebriate or affect the Head, but attenuates the Fluids, and runs off either in a Diarrhæa or Dyſentery. If it be thus ſet by in Caſks, it ferments and turns to Vinegar; but to prevent that, it is depoſited, with ſome bitter Plant, as Hops, in a Heat of about 60 Degrees; and thus the Fermentation is reſtrained, and the Production of a vinous, inebriating Liquor, which affords an Alchohol, or inflammable Spirit by Diſtillation, not at all inferior to that obtained from Wine; but ſuch very ſtrong Ale is not healthy for ſtrong Conſtitutions.

[6] Wine, invented by *Noah*, is of much greater Antiquity than the Ale preceding, and has all along retained its moſt ancient Name *Vin*, from the primitive Languages; it is ſuppoſed to have been firſt contrived in the hot Countries, whoſe Inhabitants having but little Water, and that impure, were obliged to ſeek for a more agreeable Drink in the Grape. But the richeſt and moſt exquiſite Wine, is that which runs ſpontaneouſly from the Grapes perfectly ripe, which being laid in Heaps, burſt of themſelves, and afford the Wine we call *Nectar*. Wine drank before it has fermented, is not at all ſpirituous, but flatulent, and productive of Diarrhæa's, Dyſenteries, *&c.* yet a perfect Fermentation renders it uniform and pleaſant, ſpirituous, inebriating, or acid. — The moſt common Method of extracting this Liquor from the Grape, is by treading with the Feet of Men, or preſſing with ſome other Machine; by which means they afford a greater Plenty of Juice, but not at all compara-

ble to the former. Wines of various Kinds may be alſo obtained by Fermentation from the Juice of Strawberries, Elder-berries, and various other Fruits. Wines are generally of uſe when it is neceſſary to warm and invigorate the whole Habit of Body; but for People in Health, and thoſe in Fevers, Water is greatly preferable, to attenuate the viſcid Blood, dilute and diſcharge its acrimonious and uſeleſs Parts.

§. 57. The conſequent Effect of all theſe Preparations (§. 53, to 57.) of our Aliments, is, that their Parts are *attenuated*[1] and open'd, intimately *mix'd*[2], diluted, and render'd more *fluid*[3] and comminutable; and by ſeparating their more groſs and uſeleſs from their healthy Parts, they are thus made more perfectly *digeſtible*[4] in the human Body; alſo fitted for renewing its Parts, and paſſing the ſeveral Organs for Secretion and Excretion.

[1] Attenuation is the Diviſion of the Parts of any Body into leſſer Particles, by which means their Surfaces are increaſed; but it is the Surfaces of the Parts of our Aliments which are applied to the Powers of our digeſtive Organs; therefore by increaſing the Surfaces of the Parts of our Aliments we have the ſame Effect as if we augmented the Strength of our digeſtive Organs, which are to operate upon the Aliments.

[2] No Operation is more neceſſary to Health, than an intimate and uniform Mixture of the Parts of our Aliments; but that can hardly be effected without the preceding Attenuation.

[3] Fluidity ariſes in a great meaſure from the Lubricity, or ſmooth Surfaces of the Particles, which

by that means ſlide eaſily upon each other, without any conſiderable Friction; that Lubricity of Parts may be alſo made by ſtriking off their Inequalities or Aſperities by Friction from repeated Motion.—The common People often eat various Aliments without hardly ever drinking; which Aliments are however digeſted and turned into Fluids; but that muſt be done by attenuating their Parts, and giving them ſmoother Surfaces.

4 Some Parts of our Aliments are perfectly aſſimilated by the Powers in the human Body, ſo as to become abſolutely Part of ourſelves; but there are other Parts which reſiſt the Force of all our Organs, and are therefore caſt out of the Body unaltered; thus in the firſt Digeſtion we meet with the Skins of Cherries, Gooſeberries, *&c.* entire in the Feces, and but little altered; and ſo alſo, in the Urine after the ſecond Digeſtion; ſuch Parts ought therefore to be ſeparated from the reſt, which we find is performed by the Actions of the Parts in the human Body: but the Aliments are by theſe Preparations in a great meaſure previouſly ſubjected to ſuch a Separation, to facilitate their ſubſequent Digeſtion in the Body. A Perſon that drinks Fleſh Broths, does not require ſuch a Force to be exerted by the digeſtive Organs, as if he eat the ſolid fleſhy Parts, whoſe Fibres are to be broke in ſunder to diſcharge their nutritious Juices. *Lower* tells us of a young Man almoſt kill'd with frequent Hæmorrhages, whoſe Life was ſuſtained by conſtant drinking of Fleſh Broths, who muſt otherwiſe have periſh'd through Weakneſs.—So that all theſe Preparations of our Aliments are done in Imitation of Nature, to eaſe her.

Maſtication

Maſtication of the Aliments.

§. 58. THE various Kinds of ſolid *Food*[1] (§. 49, to 52.) thus prepared *(per* §. 57.) undergo ſeveral other Changes in the Mouth; (1.) by biting, (2.) by *Maſtication*[2], and, (3.) by mixing with Particles of Air the Saliva, and other Fluids diſcharged into the Cavity of the Mouth.

[1] Nature and Method directs us to conſider, I. The Nature of the Aliments, (§. 49, to 57.) II. The Inſtruments of Aſſimilation, by which the Aliments are converted in Part of ourſelves, (§. 58, to 433.) and III. The Hiſtory of the Matter itſelf, which is by that means applied to renew the Parts of the Body, (§. 434, to 480.)

[2] By Maſtication we underſtand the Comminution of the ſolid Aliment by Trituration in the Mouth, being at the ſame time diluted with the Saliva; the chief Object of this Operation is the ſolid Aliment to be comminuted, in order to give their Parts a larger Surface, that they may be more eaſily digeſted by the Powers of their proper Organs in the human Body; though as a ſecondary Object of this Operation, we may take in Spices, and other Sauces, which are uſed more for Pleaſure than as Aliment. To explain the Buſineſs of Maſtication, is to aſſign the Cauſes by which the Aliment is ground together in the Mouth.

§. 59. The firſt thing required in *biting*[1] or dividing our Aliment, is an Abduction of the lower *Jaw*[2] down from the upper, towards

the Breaſt, turning upon its *Condyloide* Proceſſes, which are articulated to the *Protuberances* 3 of the *Oſſa Temporalia* by a Ligament inveſting the whole Articulation, between which is interpoſed a ſmall moveable *Cartilage* 4, concave on each ſide, and affixed to neither of the Bones, but connected by its Margin to the circular Ligament inveſting the whole Articulation; being lubricated on each of its Concave Surfaces with a mucilaginous Liniment preſſed out of the Cells which inveſt the Articulation. In the next place biting requires the lower Jaw to be again forcibly preſſed up againſt the upper Jaw, that whatever Aliment is interpoſed betwixt the Eight foremoſt Teeth (term'd *inciſores*, and placed in each Jaw oppoſite to one another) may be cut aſunder by them.

[1] Biting is the Action by which the ſolid Aliment is broke into ſmall Parcels by the Teeth; the Neceſſity of which Operation is evident in ſeveral of the harder Kinds of Food which Men eat, ſuch as Nuts, *&c.*

[2] The lower Jaw conſiſts of two Parts in the Fœtus, that it may the more eaſily be extended in Growth; but in the Adult it is one continu'd Bone. A Fracture of the lower Jaw will obſtruct the Action of Deglutition, as we have an Inſtance in a celebrated Duke, who had his lower Jaw broke by a Bullet; whenever that Nobleman ſwallowed any of his Food, he was obliged firſt to put it upon his Tongue with his Fingers. The lower Jaw is moved in various Directions upwards, downwards, backwards, forwards, and to each ſide, and in all Directions compounded of theſe like a Mill-

ſtone;

ſtone; for as in a Mill one Stone which is moveable grinds the Corn upon another which is fixed, ſo the lower Jaw grinds the Aliment againſt the immoveable upper Jaw.

[3] It has been the Opinion of moſt Anatomiſts, that the lower Jaw is articulated in a *Sinus* of the ſquammoſe Part of the *Os Temporale*, ſituated before the *Meatus Auditorius*; but *Ravius* firſt obſerved in himſelf, and in many Diſſections, that this Cavity is filled with a glandulous and adipoſe Subſtance, which ſerves to quicken and facilitate the motion of the Joint; and when abſent, occaſions a diſagreeable grating of the Bones in Maſtication; but he found that the *Condyloide* Proceſſes of the lower Jaw were articulated with the Protuberances of the *Oſſa Temporalia*, placed before thoſe Cavities, to whoſe Figure that of the *Condyloide* Proceſſes correſpond.

[4] In every Articulation of the moveable Bones, we meet with, 1. ſmooth Cartilages inveſting the Heads of the Bones, and lubricated with their proper Mucilage. 2. Ligaments and Capſulæ, which inveſt the Heads of the Bones, and ariſe from the *Symphyſis* of the *Diaphyſis* with the *Epiphyſis* of the Bone, which *Columbus* truly remarks; but theſe *Epiphyſes* ſeparate from the Body of the Bone in young Subjects, and are kept diſtinct from their proper Bones in *Ravius*'s Repoſitory. 3. The lubricating Mucilage from *Haver*'s Glands, expreſſed from the Arteries in form of the White of an Egg. But beſides all theſe Particulars, which are in common to every Articulation, the lower Jaw has alſo a particular Mechaniſm of its own, by which it is articulated with the upper, to prevent its Cartilages, and thoſe of the *Oſſa temporalia*, from being wore out or ground away by the daily Attrition which they ſuffer in Maſtication; for beſides the

two

two cartilagenous Coverings which inveſt the Heads of the lower Jaw, and thoſe Parts of the *Oſſa temporalia*, to which they are connected, there is alſo interpoſed a moveable Cartilage, concave on each ſide, into which Cavities are receiv'd the Tubercles on each of the lower Jaw, faſten'd together by a circumambient Ligament.

§. 60. The lower Jaw is pulled down in this *Action* [1], by the Contraction of the two *digaſtric* [2] Muſcles, which ariſe fleſhy from a ſmall Cavity in the Baſis of the *Maſtoide* Proceſſes; and in their Deſcent form Tendons, which paſs through the *Stylo-hyoide* Muſcles, and the annular Ligament fixed to the Sides of the *Os Hyoides*; from whence again they become fleſhy, and being furniſhed with fleſhy Fibres from the *Os Hyoides*, they aſcend to their Inſertion, in the inſide of the lower Margin of the *Os Maxillare inferior*, at the middle of the Chin, being the lowermoſt of all the Muſcles inſerted at that Part of the Chin, by which *Mechaniſm* [3] theſe Muſcles are found to act with the Power and Direction of the Pully, through which their Tendons paſs in a very artificial and ſurpriſing *manner* [4]; ſo that theſe Muſcles can perform their proper Office by the Contraction of their Parts inſerted into the Chin, and alſo by thoſe which are inſerted into the *Maſtoide* Proceſſes of the Head, without any Injury to the Parts, or obſtructing the Action of the other.

[1] The lower Jaw may be eaſily pull'd down from the upper, ſo as to intercept the ſecond Joint of the Thumb;

Thumb; but if it is pull'd down lower, there is danger of a Luxation.

[2] The *Coracohyoidei* Muſcles are alſo Digaſtrics or Biventres, but they have no relation to the Mechaniſm of theſe; and when they were formerly called *Biventres* by Anatomiſts, they were alſo diſtinguiſh'd by the Epithet *Colli*.

[3] The Action of every Muſcle is to contract, or ſhorten in length, and by that means to draw the moveable Part of its Inſertion towards the leſs, or immoveable Part, in a Direction which approaches neareſt to a right Line. Were the digaſtric Muſcles to act in ſuch a Direction, they would not pull the lower Jaw down, but directly upward and backward; their Direction is therefore changed, by faſtening their middle Tendon to a Pulley, which in Infants is a callous Membrane, but in Adults a cartilagenous Ring; they thus paſs in an angular Direction, their fix'd Point being at the *Os hyoides*; ſo that one Part of the Muſcle being contracted, the other muſt follow, and pull the lower Jaw, not towards its Origin, at the *maſtoide* Proceſs, but downwards, toward the *Os hyoides*.

[4] It was neceſſary that there ſhould be ſome Muſcles proper to the Abduction of the lower Jaw from the upper, tho' there was no occaſion for them to be large, nor very numerous, ſince the lower Jaw's own Weight, and free Suſpenſion for Motion, ſo facilitate its Deſcent from the upper, that in ſleeping, and in apoplectic and paralytic Perſons, it is generally found in that Poſture, but more diſagreeably gaping; yet it was neceſſary there ſhould be ſome Muſcles for this Office, to overcome the natural tonic or contractile motion of the elevating Muſcles, which conſtantly ſuſtain the Weight of the lower Jaw from ſubſiding when we are awake. The *quadratus genæ*, or *latiſſimus colli*,

colli, would not have been ſufficient to pull the Jaw down of itſelf, if it aſſiſts in that Action; becauſe its Force is ſpent in corrugating the Skin of the Neck, Face, and Chin; nor has it a ſuitable Origin and Direction from and over the *Sternum* and *Clavicle*; nor does it paſs along the Neck, ſo as to be inſerted into the lower Jaw. A Muſcle is therefore contrived by a wonderful Mechaniſm, ſo as to perform the ſame Office which it would have done in an oppoſite Direction to its Origin and Progreſs. But it is alſo probable that the Elevation of the upper Jaw from the lower by the ſtrong *Splenii*, *complexi*, *&c.* Muſcles which pull back the Head, does alſo contribute to the opening of the Mouth; for we find that a Dog will growl notwithſtanding his lower Jaw be held firm upon a Stone Table, *&c.*

§. 61. The latter Action (§. 59.) or Adduction of the lower Jaw to divide the Aliment, is performed by the Contraction, (1.) of the *Temporal Muſcles*; which ariſe by a broad, ſemicircular, and fleſhy Origin, from an Excavation in the *Os Frontis*, the Top of the *Spheroides*, and *Os Temporale*, from whence the Fibres running together, are united under the *Os Jugale*, being alſo ſtrengthened and directed by other Fibres received from the ſame Bone, they are inſerted, partly fleſhy, and partly tendinous, into and round the *Proceſſus Corones* of the lower Jaw. (2.) By the Contraction of the *Maſſeter Muſcles*, which ariſe thick and fleſhy from the firſt Bone of the upper Jaw, the *Os Jugale*, from whence its Fibres croſſing each other, are inſerted into the external and lower

lower Margin of the lower Jaw, for about four Fingers breadth from its Angle towards the Chin. (3.) By the Contraction of the *Pterugoidei externi* [1], which ariſe from the external Face of the outer Wing of the *Proceſſus Pterugoides*, belonging to the *Os Sphenoides*, whence deſcending backward, they are inſerted by a ſtrong Tendon within ſide the ſemilunar Space betwixt the *Condyloide* and *Coronoide* Proceſſes of the lower Jaw; when theſe Muſcles act together, they draw the lower Jaw upwards and forwards, and obliquely forwards to one ſide, when only one of them acts. (4.) By the Action of the *Pterugoidei interni* [2], which ariſe fleſhy and tendinous from the whole internal Surface of the outer Wing of the *Pterugoide* Proceſs, thence deſcending to their Inſertion, by a ſtrong and broad Tendon, into a ſmall Excavation a little above and within ſide the Angle of the lower Jaw, under the *Condyloide* Proceſs; when both theſe Muſcles act together, they pull the Jaw very ſtrongly upwards and backwards, like the *Maſſeters*, and obliquely backward or to one ſide when only one of them acts. Now if theſe eight deſcribed Muſcles contract together, they preſs the lower Jaw againſt the upper with an *incredible Force* [3], the whole Force terminating in the two Rows of *Teeth* [4] placed in each Jaw; and thus the eight *Dentes Inciſores* being ſtrongly preſſed together, the Act of biting is performed.

[1] Theſe muſt pull the lower Jaw forwards, becauſe their Origin at the immoveable Bone is more forwards

forwards than their Inſertion into the Jaw; but when they act in conjunction with the digaſtric and temporal Muſcles, they then move the Jaw backwards and upwards.

[2] If only one of theſe act, it draws the lower Jaw to one ſide; but contracting both together, they elevate it.

[3] The great Strength of the Lion, the *Britiſh* Maſtiff-Dog, and all Sorts of voracious Animals in general, conſiſt in theſe eight Muſcles. *Veſalius* tells us of having ſeen an Actor who took up an Iron Pin of twenty-five Pounds Weight in his Mouth, and reclining his Head backward, flung it nine and thirty Foot behind him with ſuch a Force, that it ſtuck into a Beam at that diſtance; and of another, a *Turk*, who would carry a Beam in his Mouth of a Weight ſufficient to load any ſtrong Man; and I myſelf have ſeen a Man take an empty Hogſhead in his Teeth and carry it about with eaſe; and another Man who would lift prodigious Weights by a Rope with his Teeth. Phrenitic Patients ſometimes ſhut their Jaws with ſo much Violence as to break off pieces of their moſt hard Teeth. In theſe Actions the *Dentes inciſores* ſuſtain the biggeſt Force, which are therefore made of a more compact Subſtance than the *Molares.*

[4] All the Teeth may be diſtinguiſh'd into four Claſſes. I. The *Inciſores*, fix'd perpendicular with one ſolid Root, forming a Wedge or Chiſſel by a circular Excavation within, being eight in Number, four in each Jaw; the Office of theſe is to bite, cut, and tear the Aliment, not to grind it; they are the firſt that appear in Infants, at the time when they live upon fluid Aliments, requiring no Maſtication. II. The four *Canini*, placed one on each ſide the *Inciſores*, with a ſingle Root, being very

very ſtrong, and of a conical Figure, terminating in a ſharp Point, fit to hold faſt and lacerate the more tough Aliments. Ruminating Animals having no Uſe for theſe Teeth, are always without them; they are much ſtronger than the *Inciſores*, and ſerve to hold the Aliment faſt, that it may be the better divided by the reſt of the Teeth. III. The *anterior Molares*, eight in Number, placed two on each ſide of the *Canini*, having a ſomewhat plain, but rougher Surface than the reſt, and faſtened with a double Root. IV. The *poſterior Molares*, twelve in Number, three of a ſide in each Jaw, having broad, flattiſh Heads, with rough Surfaces, and faſtened with three or four Roots; upon theſe the Aliment is chiefly comminuted into ſmaller Parts, and ground into a ſoft uniform Maſs, like Fruits which have been ground between two Stones in a Mill; therefore graniverous Fowls, who have none of theſe Teeth to grind the Grain they feed upon, have very ſtrong Stomachs, which being ſtuff'd with ſmall angular Stones, performs the Office of our *Dentes molares*. The Subſtance of the Roots and internal Part of the Teeth is boney, but their external Covering is different from any of the other Bones, approaching the Texture of the hardeſt Marble.

§. 62. The Food being thus divided by biting, is then *preſſed*[1] between the rough and large Surfaces of the *Dentes Molares*, to be there further comminuted by grinding. 'Tis forced in betwixt the Grinders, (1.) by the Contraction of the *Buccinator*[2] Muſcle, which (ariſing broad and fleſhy from the anterior Part of the *Proceſſus Corones* of the lower Jaw, adheres faſt to the Gums of each Jaw by direct Fibres, which

which paſſing along the Cheeks, are inſerted into the Angles of the Lips, and) preſs the Cheeks cloſe to the outſide of the grinding Teeth: (2.) By the *Orbicularis Labiorum* or Sphincter of the Mouth, which (being faſtened by membranous Ligaments to the Gums in the middle of the upper and lower Lip, encompaſſes the Mouth and Lips with its fleſhy Fibres, and) is inſerted into no Bone, but corrugates, contracts, or ſhuts the Mouth. (3.) By the *Zeugomatic Muſcles*, which ariſe fleſhy from the external Part of the *Os Jugale*, whence deſcending obliquely, they are inſerted into the Angles of the Lips, which they draw obliquely upwards, and preſs a Portion of the Cheek, near the upper Part of the *Buccinator*, againſt the Gums of the upper Jaw. (4.) By the *Elevator labiorum communis*, which ariſing from the fourth Bone of the upper Jaw, deſcends obliquely to its Inſertion at the Corners of the Lips, under the Tendon of the preceding Muſcle, and moves the Lips more directly upwards, compreſſing them and the adjacent Part of the Cheeks againſt the Teeth and Gums: (5.) By the *Elevator labii ſuperioris proprius*, which is a double Muſcle, one Part ariſing above the other from the fourth Bone of the upper Jaw, and deſcending obliquely, terminates in an Expanſion under the Skin of the upper Lip; the other Part of the ſame Muſcle ariſes from the anterior Part of the upper Jaw, about the middle of the Baſis of the Noſe, and is diſperſed into the middle of the upper Lip, theſe Muſcles acting

acting together, preſs the upper Lip, contracted by the Sphincter Muſcle, againſt the anterior and ſuperior Teeth and Gums: (6.) by the *Depreſſor labii inferioris proprius*, which ariſes from the lower Part of the Jaw-bone at the Chin, and is inſerted into the lower Lip. (7.) By the *Elevator labii inferioris proprius*, which ariſes from the anterior Part of the Gums and lower Jaw, about the *Dentes Inciſores*, and is inſerted into the Skin of the lower Part of the Chin. Theſe Muſcles, by the Aſſiſtance of (8.) the *Depreſſor labiorum communis*, which ariſes fleſhy from the inferior Margin of the lower Jaw, and aſcending on the Side thereof, is inſerted in the Angles of the Lips. (9.) The oblique Muſcles of the lower Lip, ariſing from the middle of the forepart of the inferior Margin of the lower Jaw, aſcending obliquely into the lower Lip. (10.) By the *Platyſma Myoides*, or *quadratus genæ*, which being extended immediately under the Fat, ſpreads almoſt over the whole Breaſt, down to the Paps, forming a broad membranous and tendinous Expanſion upon the upper Part of the pectoral Muſcle, from whence it is continued above the *Clavicles*, over the Neck, under the Chin, and over Part of the Face, above the Maſſeter Muſcles, as high as the Baſis of the Noſe, ſtrictly binding together with its tendinous Fibres all the Muſcles it paſſes over, and applying the Cheeks to the grinding Teeth and Gums, and variouſly contracts and moves the Integuments of the Breaſt, Neck, Chin, and lower Part of the

Face. —— When all the Muſcles act together, both the Cheeks and Lips are then ſo ſtrongly preſſed againſt the Gums and Teeth, that no Part of the ſolid or fluid Aliment can fall down between the Teeth, Gums, and Cheeks; but if they act ſucceſſively one after another, the Aliment is then determined to various Parts of the Mouth. The Action of theſe Muſcles is antagoniz'd within ſide the Teeth by the *Tongue* 4, which keeps the Aliment from ſlipping down on its Side, and alſo preſſes it between the Teeth, being a Muſcle the moſt voluble or nimble at Will of any in the Body, and capable of being eaſily moved to all Parts of the Mouth. The Tongue performs its Motions, (1.) by the *Genioglosſi* Muſcles, which ariſe fleſhy from the internal Part of the Chin, and dilating as they proceed backward, are inſerted into the Root of the Tongue, ſerving to contract the Sides, and draw the Tongue forwards. (2.) By the *Ceratogloſſi*, which ariſe broad and fleſhy from the Side of the *Os Hyoides*, from whence aſcending, we perceive them diſperſing their Fibres plentifully through the Tongue, which they ſerve to pull back, preſs down, and flatten. (3.) By the *Stygloſſi*, which ariſe ſharp and fleſhy from the external Part of the *Proceſſus Styloides* 5 of the *Oſſa Temporum*, whence deſcending obliquely forwards, they are inſerted into the back Part of the Tongue, which they elevate, draw to each ſide, or flatten, as they ſend out fleſhy Fibres to the internal Sides of the lower Jaw. (4.) By the muſcular

muſcular Fibres, which form the *Body of the Tongue*[6] itſelf, ſome of which are longitudinal, ſhortning the Tongue, others tranſverſe, making it narrower; ſome again are perpendicular, expanding it thin, and flat; others contracting the back Part and Sides thereof, make it ſharp-pointed, and draw it inwards; others depreſs it in the ſame Figure; and laſtly, there are ſtraight Fibres, which contract the Root of the Tongue together. By all theſe various Muſcles and Fibres acting ſeparately and conjunctly, we may eaſily account for the Determination of the Aliment by the Tongue between the grinding Teeth and the Conveyance of the fluid as well as the ſolid Aliment, by the ſame Organ towards the *Fauces* and *Oeſophagus*, eſpecially when the joint Action of thoſe Fibres which paſs from the Tongue amongſt the external Muſcles, which both act together, and by that means the ſolid or fluid Aliment, which ſlips down under the Tongue, or on each ſide of the lower Teeth, is readily taken up, and laid upon its Back, in order to be ſwallowed.

[1] The great Number of Muſcles which are here enumerated for the Office, all of them act at Pleaſure, or the Influence of the Will; and ſuch is their Connexion with each other, that if one becomes paralytic, all the Aliment will be forced by the Action of the reſt to that Part of the Mouth near the paralytic Muſcle, inſomuch that the Patient is oblig'd to ſupply the place of that Muſcle by preſſing the Cheek with his Hand; the ſame thing happens when we are about to ſwallow even ſo

much as a Drop of *Saliva*, ſo that the Cheeks leave no Cavity, but preſs all the *Saliva* upon the back of the Tongue. Theſe Muſcles have been well pictur'd by *Euſtachius*, who was not only aſſiſted herein by Plenty of Bodies, but even thoſe too of the lean and various countenanc'd *Italians*, in which Subjects it was much eaſier to prepare the Muſcles of the Face, which are interwoven with Skin and Fat, than in the more plump'd-fac'd Inhabitants of the Countries which are nearer to the North; and *Santorinus* has even ſurpaſſed the Induſtry of *Euſtachius* in his Obſervations upon this Head.

[2] The buccinator Muſcle is of great Efficacy, as well in preſſing the Cheeks againſt the Teeth, by which means the firſt Cavity of the Mouth is cloſed, as by compreſſing the ſmall Glands of the Cheeks, and by that means ſolliciting them to a more plentiful Secretion of *Saliva*; if theſe Muſcles become paralytic, the Patient cannot chew his Aliment; for whatever he takes in his Mouth, is thruſt out on each ſide of his Cheeks.

[3] This Muſcle gave occaſion for *Galen* to imagine that there was an univerſal *Panniculus carnoſus*, which he affirms to be extended like a Muſcle next to the Skin all over the Body; but tho' this Mechaniſm is frequent in Brutes, there was no occaſion for it in a human Body, becauſe Inſects and other Nuiſances might be remov'd by the Hands.

[4] The Tongue has ſo many Uſes, that it is no eaſy matter to recount them all; it is the Organ of Taſte, the Articulator of Speech, and a great Inſtrument in Deglutition; but it alſo ſhares a great Part in the Buſineſs of Maſtication, which is quite different from that of Deglutition; inſomuch that if the Tongue becomes paralytic on one ſide, the Patient cannot chew his Aliment on that ſide.

[5] The

[5] The *Os Styloides* is not a Proceſs of the *Os Temporale*, as Anatomiſts generally imagine; but a diſtinct Bone, which is faſtened by Ligaments to the *Os Petroſum*, as *Ruyſch* firſt demonſtrated to us in old People; indeed the Articulation is obliterated, and the *Os Styliforme* becomes continuous with the *Os Petroſum*; but even in the *Cranium* of Adults it is eaſily broken in that Part, and is hardly ever to be found entire in the Skulls of the Church-yards

[6] The Muſcles of the Tongue, of which it is chiefly compoſed, give it that exceeding Volubility or Nimbleneſs which we find in the human Tongue; for the internal Structure of the Tongue is truly an inſcrutable Muſcle, the Texture of which has been deſcribed by no Body before *Malphigius*; nor even has he expoſed the Texture of the Fibres belonging to the Tongue in a human Subject, but in that of a Calf; for the human Tongue is ſo ſmall, ſo tender, and ſo intermixed with Fat, that its Structure is obſcured, and nothing can be diſtinctly obſerved. The Tongue of an Ox exhibits the internal Structure not only more evident by its Magnitude, but its Fibres are alſo more conſpicuous, by their more frequent Action in cropping the Meadows. So various are the Directions of theſe Fibres, that there is no Arch of a Circle but what may be freely deſcribed by the Tongue; to diſſect this Part, it ſhould be firſt boiled in Water, and often ſhifted, till there remains nothing of the Fat mixing itſelf with the Water; then pinning it down, firſt remove the Cuticle, and then the perforated *Corpus reticulare*, then the papillary Covering, and their adhering *Adeps*; and thus you may have a diſtinct View of the muſcular Fibres.

§. 63. From hence it evidently appears in what manner the Aliment is ground and attenuated by the Action of the Muſcles moving the Jaws, (§. 60, and 61.) being firſt divided by opening and ſhutting them, then preſſed on each ſide betwixt the grinding Teeth, by the Muſcles of the Cheeks, Lips and Tongue; where, being ſufficiently comminuted, it is conveyed backwards to the *Oeſophagus*.

§. 64. By this Preparation in the Mouth, the Aliment undergoes the ſame Changes as have been already mentioned (at §. 57.) *viz.* 1. a farther Attenuation and more intimate Mixture of their Parts. 2. It undergoes ſeveral other Changes with being mixed with Saliva and Fluids of the Mouth, with the Mucus of of the Palate and *Fauces*. 3. And laſtly, it receives other Alterations, the ſmall Particles of Air which are intermixed and retained by the viſcid *Saliva*.

Of the Origin, Nature, and Mixture of the Saliva *with the Aliments.*

§. 65. THE *Saliva* flows into the Mouth from 1. the *Parotides*, two conglomerate Glands, ſituated each in a Cavity at the Root of the Ear, between the *Condyloide* and *Maſtoide* Proceſſes, belonging to the lower Jaw and *Os Petroſum*, under the *Os Jugale*;

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it contains a *conglobate Gland*[1], within ſide, and is largely extended forwards, backwards, and downwards, ſomewhat in a triangular Figure; theſe Glands do by their Structure ſeparate the *Saliva* from the *Arterial Blood*[2], and convey it when ſeparated, each into one *common Duct*[3], which diſcharges it into the Mouth through the *buccinator Muſcle*[4], near the third of the upper grinding Teeth: 2. from the *ſub Maxillares*, two conſiderable Glands, ſituated one on each Side, juſt within the inferior Margin of the lower Jaw, being large towards the Angle of the Jaw, and extended ſmaller under the whole extent of *Dentes Molares*; theſe alſo ſeparate *Saliva* from the arterial Blood, and diſcharge it into a long *excretory Duct*[5] ariſing from its poſterior Part, and continued almoſt to the *Dentes Inciſores*, receiving the *Saliva* by its ſeveral lateral Branches which communicate with the Parts of the Glands, and diſcharging it by two of the Emiſſaries under the Tongue, near the Baſis of its *Frenulum:* 3. from the *Sublinguales* of *Rivinus*, and *Bartholin*; which are perhaps no more than a Continuation of the laſt mentioned Glands, diſcharging their *Saliva* in the ſame Part of the Mouth by many ſmall Ducts on the Sides of the other Ducts, under the Tongue: 4. from the *lenticular and miliary Glandules*, whoſe ſmall Emiſſaries perforate the *Tongue*[6], *Palate*[7], Gums, Lips, and Cheeks, diſcharging a much thinner *Saliva* than the reſt, but of the ſame Nature; and laſtly, 5. from the ſmall Glands in the back

Part of the Palate, or *Fauces*, of the *Uvula* and *Tonſils*, which diſcharge a more thick or mucous *Saliva*, mixing with the Aliment. —— And ſuch is the Situation of theſe Glands and Emiſſaries, that they afford their Fluids moſt plentifully when they are *moſt required*[8], *i. e.* in the Action of Maſtication and Speaking. Though there are ſome who reckon ſtill more ſalival Glands and Ducts than thoſe now enumerated; but their Exiſtence in the human Body may juſtly be queſtioned.

The Effects and Changes wrought on Aliments by the *Saliva* are very conſiderable. The ruminating Animals, as the Ox, *&c.* feeding upon nothing but dry Hay, have a remarkable Contrivance to draw out its nutritious Juices; they firſt ſwallow it entire, after rolling it up into large Balls in their Mouths, being in that State quite indigeſtible by them; the dry Hay being thus moiſtened with the *Saliva*, and conveyed into the firſt Stomach, is further ſoftened by the warm Juices of that Stomach, and its tough Fibres are thus more eaſily fitted for a further Diviſion; the Animal then ruminates, or again throws up the round Morſules of Hay into its Mouth, where it is minutely ground by a ſlow and careful Maſtication between the grinding Teeth, and ſo intimately blended with the *Saliva*, as to make a copious Froth or Foam; ſo that the ſmall Veſſels of the Hay being thus mollified and broke, and again ſwallow'd, it eaſily parts with its nutritious Juices in the true Stomach. Were we prudently to imitate this Artifice, we might put off Hunger much longer by the ſame Aliment, extracting more nutritious Juices from it by a well chewing, than by devouring it

in large Mouthfuls, almoſt untouch'd by the Teeth.

[1] It is remarkable in the parotid Glands, that beſides their conglomerate Structure, they contain each a large conglobate Gland, which inſerts its Duct into the common excretory Duct of the whole Gland; but what ſhould be the Uſe of it? it can hardly be to pour a Lymph into the *Saliva*, to attenuate it in its Courſe; for Lymph coagulates with Fire, but the *Saliva* evaporates; it muſt therefore be of the ſame Uſe with the other Parts of that ſalival Gland.

[2] The ſame Blood which affords the moſt ſubtil Fluid of the Nerves in the Brain, does alſo yield the *Saliva*, by many ſmall Branches of the external carotid Artery, diſperſed thro' the parotid Glands.

[3] This Duct is conſiderably large, and upon Preſſure yields a large Thread of *Saliva*, which runs very ſenſibly cold into the Mouth, or upon the Tongue, when the Duct and Gland which lie under the Skin have been cooled by a Blaſt of cold Air upon the Face; while the internal Parts of the Mouth remain much warmer, by being ſhut, and defended with its proper Muſcles.

[4] The *Saliva* is preſſed out of this *Ductus Stenonianus* by the Contraction of the *Buccinator* and *Maſſeter* Muſcles; but the Duct did not paſs under thoſe Muſcles, leſt the *Saliva* ſhould have been wholly obſtructed by too great a Preſſure. It frequently happens after inveterate Pains of the Teeth, that theſe parotid Glands are poſſeſſed with Tumours, which ought never to be extirpated, becauſe upon dividing any of the ſalival Ducts they do not heal up, but degenerate into an incurable Ulcer, continually pouring out *Saliva*; and in the mean time thoſe Parts of the Patient's Mouth are very dry, which ought to have been ſupplied with

Saliva

Saliva by their proper Ducts. — The Duct opens itſelf into the Mouth by a circular and prominent *Papilla*, or Eminence, which freely admits the *Saliva* into the Mouth, but reſiſts a Blow-pipe, Probe, or other Body, with a conſiderable Force.

[5] Theſe Ducts were firſt diſcover'd by *Wharton*, and are ſo large and conſpicuous in a Man that is faſting, that if he looks in a Glaſs while he is affected with a ſapid Body, he will perceive them ſpout out a little long watery Stream of *Saliva*, which is forced out by the Action of the *pterugoidei* and digaſtric Muſcles. — In theſe Ducts there are calculous Concretions frequently formed.

[6] The Tongue has not only a Covering of exceeding ſmall Veſſels, which *Ruyſch* injected with Wax, but it has alſo a glandular Expanſion, made up of ſmall Glands, which pour out the Humour, continually moiſtening the Tongue, whoſe excretory Duct was firſt obſerved by *Vaterus*.

[7] By the Palate we intend the membranous Covering, which is full of ſimple Glands, inveſting the Palate, and which is continued even thro' the Noſe, *Fauces*, pituitary *Sinuſſes*, *Gula*, *Larynx*, Wind-pipe, Stomach, and Inteſtines; this Covering is uſually called from its Inventor, *Membrana Schneideriana*; in whoſe ſimple Glands are ſeparated a Humour, which is at firſt a very thin Fluid, but by ſtanding in their *Folliculi* becomes a thick *Mucus*, to be preſſed out whenever there is a Call for it. There are alſo the like mucous Receptacles diſperſed about the *Uvula*, *Epiglottis*, and *Fauces*. The Diſorders of this Membrane are included under one common Title, *viz.* *Catarrhales*; in the Noſe it conſtitutes a *Coryza*, in the *Fauces* an *Angina*, and in the *Larynx* a *Cynanche*. In this Membrane is ſeparated all that *Mucus*, whoſe Viſcidity in a healthy Body is ſometimes ſo great as to

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be hardly ſeparable; and which Ancients for a long time imagined to come from the Brain. The preſent Viſcidity of this Humour is no Argument that it was not very fluid before; for I may be bold to aſſert that there are no Humours ſeparated in the human Body, but what are at their firſt Secretion perfectly thin and fluid; but thoſe which are more thick and tenacious, become ſo from a thinner State, by Stagnation and Warmth of the Parts. The *Semen*, Bile and Earwax, with the Fat, which are the moſt viſcid Fluids in the Body, were thin and limpid when firſt ſeparated from the Blood, but become inſpiſſated by ſtagnating in their Cells. But provident Nature has given a mucous Fluid for the Defence of all thoſe Parts of the Body, which are to ſuffer any great Attrition, or ſuſtain the Acrimony of any Fluid it is to retain or convey. Therefore not only the Paſſages for the Air and Aliments are lined with this *Mucus*, of whoſe Glands *Schneiderus* has writ five thick Volumes; but alſo the whole Surface of the urinary Paſſages, the Bladder, *Urethra*, *Vagina*, *Uterus* and external Parts of the *Pudenda*, abound with theſe mucous Receptacles. But this *Mucus* is not only of an aqueous, but alſo compounded of an oily Subſtance, that it may the better obtund Acrimony, and abate Friction. In this reſpect Sailors imitate Nature, by oiling or ſmearing their Hands with Pitch when Ropes are to run through them, which prevents them from being excoriated.

[8] The celebrated *Nuck* found a ſalivary Duct in a Dog, which paſſed from its Gland in the Orbit into the Mouth. But that excellent Anatomiſt was too haſty in placing that among the ſalivary Ducts of the human Body, ſince neither he, nor any Body after him, could ever find it there. We are altogether certain there muſt be ſome Uſe for this Duct

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in the Dog, which the human Body has no need of; therefore, as the Dog does not ſweat when he is very hot, but exhales Plenty of Vapors by the Mouth when he runs panting and blowing, this Duct ſeems to increaſe the Diſcharge that way, by which he is freed from his ſuperfluous Moiſture. However, there are yet two ſmall *Tubuli* proper to the human Body, which paſs from the lachrymal Sacks into the Mouth, about the middle of the upper *Dentes Inciſores*, through which one may thruſt a ſmall Briſtle or Hair; theſe diſcharge a great Quantity, but only the thinneſt Part of the Mucus and Tears into the Mouth.

§. 66. The *Saliva*[1] is a thin tranſparent Humour, almoſt void of Smell and *Taſte*[2], which does not coagulate, but entirely evaporates with a *ſtrong Heat*[3], and upon Agitation forms a ropy and laſting *Froth*[4]; being ſeparated from the *pure*[5] arterial Blood by its proper Glands, from whence it flows more *plentifully*[6], fluid and ſharp into the Mouths of hungry People; but after long faſting is extremely *acrimonious*[7], *deterging*[8], penetrating and *diſſolving*[9]: it will excite and augment *Fermentation*[10] in Syrups, Juices, Bread, and mealy Vegetables; after long faſting it gently ſcowers the Membranes of the *Fauces*, *Oeſophagus*, Stomach, and Inteſtines, and is conſtantly ſwallowed without notice in the healthy Bodies, as well of Brutes as the human Species, whether ſleeping or waking; when it is ſpit away too profuſely there follows *a Loſs of Appetite*[11], a bad Digeſtion, and a waſting of the whole Body; its *Compoſition*[12] being of many

many aqueous and ſpirituous Parts, which being intermix'd with a ſmaller Quantity of Oil and Salt ſtrictly united, forms a ſaponaceous Fluid.

1 The *Saliva* is not all of the ſame Kind; the thinneſt comes from the ſmall Glands of the Mouth; that which comes from the parotid and ſubmaxillary Glands is ſtill thicker; and the moſt viſcid of all comes from the ſmall Glands of the *Uvula*, the Tonſils, and adjacent Parts of the *Fauces*. To make a chemical Analyſis of the *Saliva*, one ought to chuſe that of a healthy young Man, which is ſpit without any Incentive in the Morning faſting, after having firſt waſh'd his Mouth. That fœtid Liquor which is ſpit out by the Force of Mercury in the Venereal Diſeaſe, ought not to be eſteemed *Saliva*, but a putried animal Fluid, which has been known to kill Dogs and other Animals.

2 The *Saliva* of a Perſon in Health is properly without any Taſte upon the Tongue; though in ſome morbid Diſpoſitions it is ſometimes diſagreeably ſweetiſh, in People recovering of intermittent Fevers it is Salt, and in many acute Diſeaſes it Taſtes bitter, or rank.

3 The *Saliva* differs particularly from the Lymph and Serum of the Blood, in that it wholly evaporates by a ſtrong Heat; whereas the two latter are concreted, like the White of an Egg, by a Heat equal to that of boiling Water.

4 The *Saliva* which is ſpit into Glaſſes for that purpoſe by cleanly People, will throw up a Froth upon its Surface, which will ſometimes ſtand a whole Week; which Property is an Obſtacle to the chemical Analyſis of this Fluid; for when it comes to ſuffer a ſtrong Fire, a tenacious Froth riſes,

riſes, and ſtops up the Neck of the Cucurbit, ſo as to endanger the breaking of the Veſſel.

[5] The Blood is convey'd to the Head exceeding pure, agreeable to the Principles of Hyraulics; for the *Saliva* is ſeparated from the Blood of the carotid Artery, which gives Branches to the Face, and from whence the parotid and ſubmaxillary Glands receive their Arteries.

[6] The *Saliva* continually flows into the Mouth of a Perſon in health, and nothing is a ſurer Sign to a Phyſician of Diſeaſe in a Patient, than his having a dry Mouth; but the Quantity of *Saliva* flowing into the Mouth at different times is various; when a Servant looks at, or carries a fine Diſh of Meat to the Table, he has then a ſudden and more plentiful Diſcharge of *Saliva* into his Mouth without any Influence of the Mind; whence a common Phraſe of the Mouth watering. The *Saliva* alſo abounds moſt plentiful in the Morning, when there is a larger Quantity of it retained in its proper Ducts and Glands, through the whole Night's Inactivity of the Muſcles ſerving to Maſtication, which preſs out their Contents.

[7] The *Saliva* of the Religious, who have obſerved long faſting, makes their Breath ſtink, their Spittle is alſo fœtid, acrimonious, and frets their Gums.

[8] It is a known Obſervation among the Vulgar, that the *Saliva* is efficacious in cleanſing foul Wounds, and cicatrizing recent ones; thus Dogs by licking their Wounds which are acceſſible, have them heal in a very ſhort time.

[9] The *Saliva* diſſolves colour'd Spots, cold and hard Tumours, and greaſy Spots in the Skin, *&c.* which are manifeſt Signs of its ſaponaceous Quality; it even ſo ſtrongly affects the Coats of the Stomach by its diſſolving Power, as to occaſion Hunger,

Hunger, one of the moſt violent and uneaſy Senſations.

10 It is a common Obſervation, that the *Indians* prepare their inebriating or ſpirituous Drink from a Maſtication of *Maiz* by their old Teethleſs Women, who ſpit out this Juice mixed with their *Saliva* into an earthen Veſſel, in which after a while is converted into Ale, by boiling and fermenting, which is then a Liquor extremely acceptable to thoſe People. Syrups alſo, which have been ſpit in by Accident, have been known to ferment, grow turbid, and turn ſowr.

11 When the *Saliva* is laviſhly ſpit away, we then remove one of the ſtrongeſt Cauſes of Hunger and Digeſtion; the Chyle prepared without this Fluid, is not of ſo good a Condition; and the Blood itſelf is the worſe for being deprived of this diluting Liquor. I once try'd a new Experiment upon myſelf, by ſpitting out all my faſting *Saliva*, the Conſequence was, that I loſt my Appetite; hence we ſee the pernicious Effects of chewing and ſmoaking Tobacco; for to allay the Drought which that Herb occaſions, they drown the Stomach with other Liquors, which deſtroy its Tone, and is follow'd with a Dropſy, or an univerſal ill Habit of Body. I muſt needs be of opinion that the ſmoaking of Tobacco is very pernicious to lean and hypochondriac Perſons, by deſtroying their Appetite, and weakening their Digeſtion. When this celebrated Plant was firſt brought into Uſe, it was cry'd up for a certain Antidote to Hunger; thus alſo when it became faſhionable at the *French* Court to chew Paſtils made of Wax, Cardamoms, and other Spices, it was obſerved that the Number of hypochondriacal and conſumptive People was greatly increaſed by that means. The ſame ill Conſequences

ſequences attend chewing of *Maſtich*, which is a general and received Cuſtom in *Aſia*.

[12] In the Analyſis of Bodies by Fire, we are very often diſappointed of our Ends in ſearching after their natural Compoſition. The Bodies whoſe Principles we ſearch after, are generally firſt expoſed to Fermentation or Putrifaction, in order by that means to open their Subſtance; we then apply thoſe Bodies, which have been thus changed, to the Torture of Fire, and we obtain Liquors which we give out for the Principles of thoſe Bodies; thus *Alcohol*, or an inflammable Spirit, muſt be a conſtituent Part of Wheat, becauſe the Grain, after a Fermentation, and various Treatment by Fire, affords ſuch a Spirit by Diſtillation; and thus alſo when we eat the fleſhy Parts of Animals, by the ſame Rule we muſt alſo ſwallow the moſt pungent, fœtid, and ſudorific volatile Salt, which is obtainable from them by a ſtrong Fire. But beſides theſe Difficulties, which attend every chemical Analyſis, the *Saliva* is alſo ſubject to many other inconveniences, which prevent our Examination of its Nature by Fire; with a ſmall heat it is indeed not much changed, but then it will not aſcend, but ſtays in a viſcid Form at the Bottom of the Veſſel; and if you urge the Fire ſtrongly, it riſes all into Froth. A gentle heat makes the *Saliva* ſend forth a ſomewhat acid Smell, and if its aqueous Part be evaporated to Dryneſs, twenty Ounces of *Saliva* will afford nineteen of ſimple Water, like common Water, and there remains about an Ounce of a gritty or tartarous Subſtance. If that tophaceous *reſiduum* be diſtill'd with a ſtrong Fire, it then affords a little volatile and fœtid Salt, being a Mixture of both Oil and Salt, leaving black Fæces behind, which alſo contain ſome Oil; it indeed contained no Spirit, if by Spirit you mean one that is inflammable,

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and capable of mixing as well with Oil as Water; but it contains a little Salt, which is neither of an acid nor alcaline Nature; and ſuch is the Compoſition of healthy *Saliva*; but morbid *Saliva*, which flows in mercurial Salivations, ſhoots into Cryſtals, almoſt like Nitre, which ariſe from the acid Salts of the *Mercurius Dulcis*, and are of a quite different Kind from the natural Salts of the *Saliva*; for Nitre, above all Salts, conſtantly reſults from a Mixture of volatile Acid with the ſolid and fluid Parts of the human Body.

§. 67. The *Saliva* then being *preſſed out* [1] of its Emiſſaries by the Action of Maſtication, (§. 58, to 64.) and intimately mix'd with the Food during its Comminution between the Teeth, ſerves, 1. to *aſſimilate* [2] the Aliments, or change them, ſo as to nouriſh the Body; 2. to form an intimate *Mixture* [3] of their oily and aqueous Parts; 3. to *diſſolve* [4] their ſaline Parts; 4. to excite a *Fermentation* [5], and by that means, 5. to make a Change in their *Smell and Taſte* [6]; 6. to cauſe an *inteſtine Motion* [7] in their Parts; 7. to afford ſome preſent *Refreſhment* [8] or Aliment. 8. And laſtly, to ſerve as the *Medium* [9] for Taſte, by applying the ſapid Body to the Tongue, it being of its ſelf inſipid.

[1] The *Saliva* is preſſed out by the Contraction of the ſeveral Muſcles to which its Glands are contiguous, and is always diſcharged into that Cavity where the Aliment is firſt attenuated, that is, into the Mouths of human Species; into the firſt Stomach of ruminating Animals, and into the Crops of Fowls.

[4] The *Saliva* is a Liquor ſeparated from the Blood, afterwards returned again into the Blood, and then again ſeparated into the Mouth; it is therefore a Fluid abſolutely proper to the human Body, and of a particular Kind, ſince it does not coagulate upon the Fire; but being accurately mix'd with the Aliments, it converts them into the Nature of the human Body, and forms even Bread alone, by a continued Trituration in the Mouth, into a chylous Subſtance.

[5] It ſeems to be a Circumſtance abſolutely neceſſary to perfect Health, that all the component Particles of the Chyle, Blood, and other Fluids, remain uniformly and exquiſitely mix'd, ſo that none of their Parts may flow by themſelves. Were the ſaline Parts to ſeparate from the oily, the ſmalleſt Veſſels would be deſtroy'd by their corroding Quality; the Oils by themſelves would render the Parts they poſſeſs inacceſſible to aqueous Fluids, and the Water alone would deſert all the larger Arteries and Veins, and eſcape into the ſmalleſt Veſſels. A linen Filtre, which has been dipp'd in Water, will not tranſmit Oil through its Pores, but it will readily tranſmit the ſame, if it be firſt well rubbed with Soap. In the ſame manner the oily Parts of our Aliment would not enter the minute Orifices of the Lacteals, if they were not reconciled to the aqueous Parts by the *Saliva*, and other ſaponaceous Fluids. Hence it appears how pernicious fat Aliments would be to us, if they were not to be mixed with ſomething in the Digeſtion which corrects and removes their Viſcidity; thus the *Saliva* blended together with the oily Parts, not only mixes therewith, but alſo renders them miſcible with Water. So Bread and Butter with hang'd or dry'd Meat, which is the moſt delectable Diſh of the *Hollanders*, would of itſelf turn into a rancid Chyle, yielding

inflammatory Belches; but by means of the Bread, and *Saliva*, and a perfect Maſtication, it affords a ſweet, lympid, and nutritious Chyle, which will be ſo much the better, if the Bread were Biſcuit, as that will oblige one to a more diligent Maſtication.

[4] The Power of *Menſtrua* to diſſolve Bodies, does not always proceed from any conſiderable Acrimony in them affecting our Senſes; for the Water from Whites of Eggs is ſo mild, that our Eyes will bear it without any Pain or Uneaſineſs, and notwithſtanding we ſee it will diſſolve Myrrh, by a ſaponaceous Property, which reſults from a Combination of alcaline Salt and Oil.

[5] Fermentation is drawn in by the Chemiſts to account for every Operation in Nature, while their Adverſaries as ſtrenuouſly exclude it from having the leaſt Share in any of her Appearances; but in this, both of them over-ſhoot the Mark widely; for whenever a fermentable Subſtance is excited by Heat, Moiſture, and a free Admiſſion of the Air, there muſt inevitably ariſe a Fermentation; but Bread is from its natural Texture apt to ferment and turn ſowr, which is ſtill further promoted by the *Saliva* inſtead of Water; the Air is freely admitted, and the cloſe Mouth and Stomach adminiſter Heat to it; what then can be the Conſequence, but a Fermentation? And that this is the Caſe will alſo appear from the frequent Rumblings and Belchings of Air, which is known to be generated in Fermentation. But this Fermentation is not completed in the Stomach, unleſs the Aliment ſtays there too long; becauſe neither the internal Air is retained, nor the ambient excluded, as it is in a cloſe Veſſel: But if Food ſhould ſtagnate too long in the Stomach of a weak Perſon, the Fermentation may in that Caſe be extended, ſo as to change the Aliment from its proper Nature.

[6] However various be the Mixture of our Aliment, Bread, Fiſh, Fleſh, and Vegetables, they all undergo the ſame Mixture by Maſtication, and do not loſe any of their Qualities in Deglutition; but in the Stomach *ad duodenum* they by degrees loſe their original Smell and Taſte, and turn to an uniform ſmooth Chyle, of a milky Smell and Taſte, retaining ſcarce any thing of what they had before. But there are ſome Aliments which do not ſo readily part with their natural Smell and Taſte, as Onions and Garlick, which ſmell intolerably a long time after they have been eaten, in fœtid Belches.

[7] An inteſtine Motion is that latent internal Agitation of the Parts of Bodies, which is altogether neceſſary to Fermentation; without this perturbative motion of the Parts preceding, neither Vinegar nor a vinous Liquor could be made from Malt or Sugar. But the chief Spring of this inteſtine motion in Fermentation, ariſes from the included Particles of Air, agitated and expanded by Heat; which Air never exerts its Elaſticity more, than when it is confined in viſcid Bodies; and hence that laſting and tenacious Froth upon the *Saliva*. But this ſame Air being mixed with, and retained by the viſcid *Saliva*, inſinuates itſelf into almoſt every Particle of the Aliment, and exerting its Spring by the Warmth of the Stomach, is a great Inſtrument in diſſolving the Coheſion of the Parts of the Aliment.

[8] A poor Creature that is almoſt famiſh'd, does no ſooner taſte a Biſcuit dipt in Wine, without ſwallowing any of it, but he is immediately refreſhed by it; for the bibulous Veins, which are very numerous throughout the whole Body, as well as in the Mouth and Tongue, abſorb the moſt fluid Part of the Aliment, which is by them convey'd

vey'd to the jugular Veins, and from thence to the Heart; and this Fact is ſupported, not only by Arguments from Anatomy, but alſo from thoſe Vegetables which entirely melt in the Mouth, without leaving hardly any Fæces by long Maſtication, ſuch as I have obſerved in the *Acmella Ceylanica.*

[9] No Nerve is ſenſible without it is kept moiſt; ſo that thoſe who are diſorder'd with Defluxions and Catarrhs, and thoſe who ſleep with their Mouths open, which dries their Tongue and Palate, do not taſte any thing which they put into their Mouths.

§. 68. Therefore as the *Saliva* is ſeparated with ſo great Artifice from the pure arterial Blood, and is afterwards carefully convey'd to be intimately mix'd with the Aliment in the *Mouth* [1], it ought not to be extravagantly *ſpit away* [2]; it ſhould rather have been ſwallowed, that after having performed its Offices in the Mouth and Stomach, it may be returned into the Blood; and when improved therein by repeated Circulations, be again ſecreted in a more *perfect State* [3]. And this is confirmed to be true by *Diſeaſes* [4], their *Criſes* [5], and Remedies.

[1] From hence (§. 67, 68, and 69.) it appears why none of the more perfect Animals are deprived of this Fluid, the *Saliva*; and why in Birds, and other Animals that have no Teeth, the *Saliva* is ſeparated by a particular Mechaniſm at the bottom of their *Oeſophagus.*

[2] The no leſs wiſe than bountiful Parent of all Things, has deſtin'd every Part of the Creation to

ſome proper Uſe; and as the *Saliva* is only ſeparated in any large Quantity when we are eating, it muſt therefore be deſign'd to promote the Diſſolution and Aſſimilation of our Aliment, and therefore ought not to be thrown away as uſeleſs, but convey'd into the Stomach, for further Uſe to the Oeconomy. A Patient never complains of Loſs of Appetite whilſt his Mouth and Stomach are properly ſupplied with *Saliva*; but when that Fluid is wanting, this is a conſtant Symptom. And the Perſon that ſpits out his *Saliva* in the Morning, will hardly have any Appetite at Dinner-time; but if all the Morning *Saliva* is ſwallow'd, he will be hungry enough by Noon. It is alſo allow'd by the univerſal Conſent of the more civiliz'd Nations, that ſpitting in one's Diſcourſe to any Body, is both unmannerly and naſty; inſomuch that among the Eaſtern Inhabitants it was held in the higheſt Deteſtation and Abhorrence.

[3] The thin and aqueous *Saliva* is again abſorbed by the lacteal Veſſels, and from thence conveyed into the Blood; and as theſe Parts of the Blood were ſeparated by hygraulic Laws in the ſalival Glands of the Head, they will alſo by the ſame Rule be again ſecerned in thoſe Parts in a more pure and animal State; but this Return of the *Saliva* into the Blood, and its repeated Separations again from it, may be performed ſeveral times in the Space of an Hour.

[4] There are indeed many Diſeaſes in which a plentiful Excretion of the *Saliva* is conducive to Health; but that Fluid, tho' ſeparated by the ſalivary Glands, is not at that time genuine *Saliva*. In a Salivation by Mercury in the Venereal Diſeaſe, the whole Maſs of Blood is liquify'd, and diſcharges its purulent and rancid oily Parts thro' the ſalivary Glands; which is alſo apparent from the

the ſame morbid Humours being evacuated by *Decoctum Guaici* in Sweats. And in cachectic Diſpoſitions Sialogogues and Maſticatories are uſeful, not ſo much by promoting a Diſcharge of the *Saliva*, as by expelling the ſuperfluous aqueous Part of the Blood that way, which may be alſo plentifully evacuated with ſtrong Purges by the *Anus*.

[5] A critical Diſcharge by theſe Glands in the Small-Pox may be ſalutary, by expelling the contagious Parts which occaſion ſo great Diſturbance in the Oeconomy; for upon the ninth Day the Patient's Body is covered with a thick, and almoſt continued Scab, which ariſes from a Condenſation of the purulent Matter in the confluent Kind, ſo as to form a Cruſt; if a plentiful Salivation, or ſwelling of the Fat, does not happen at that time, certain Death ought to be expected; for the purulent Matter finding no Vent at that time, by inſenſible Perſpiration, is return'd into the Blood, and proves a certain Cauſe of Death, by corrupting the whole Maſs; for that Excretion which equals five Parts out of eight, of all the other Excretions which are made in the human Body, cannot be retained in the Habit without inducing moſt pernicious Conſequences; but People of a melancholy Habit ought more eſpecially to ſwallow their *Saliva*, becauſe the waſting of that Fluid would overdrain their Bodies, already too dry.

§. 69. In the ſame Operation of Maſtication, a Quantity of *Air* [1] is alſo intimately mixed with the Food, and retained by the *Saliva* with the *Mucus* [2] of the Palate and *Tongue* [3], with which it *incorporates* [4], inſomuch that by the *Weight* [5], Fluidity and *Elaſticity* [6] of the included Air, joined with the

Heat 7 of the Body, and a continued Series of various Agitations by *Preſſures* 8, the whole Maſs of Aliment becomes more attenuated, and fluid, and the inteſtine Motion is by this means firſt introduced, and afterwards continued therein.

[1] No Fermentation can be perfectly made without Air, that Operation ſucceeding the better as there is a larger Quantity of Air intimately confined in the viſcid Parts of an aceſſent Subſtance. Bakers know this by Experience, who bake their Dough with no other View, than to raiſe and diſperſe the Air thro' its Subſtance into ſmall Veſicles or Eyes. But beſides this *included Air*, which is the ſame with the common *Ambient*, there is yet another kind of Air, which lies concealed from the Senſes within the Parts of Bodies, from whence it is never diſengaged but by the Force of Fire, a hard Froſt, or a violent Effervеſcence of contrary Salts; or laſtly, by taking off the Preſſure of the external Air; and when this latent Air is by thoſe Means extricated, it occupies a Space infinitely larger in the exhauſted Receiver than it did before; but both theſe Kinds of Air abound plentifully in the Food during its Maſtication and Mixture with the *Saliva*.

[2] This kind of *Mucus* is ſo requiſite and neceſſary to Life, that no Animal is deprived of it; and there can be no ſurer Preſage of the fatal Event of a Diſeaſe, than the Abſence of that which ſhould render the *Fauces* ſupple and ſmooth. A *Mucus* is a ſomewhat oleaginous Subſtance, thicker than Water, but miſcible with that Fluid, and ſeparated from the Blood by the moſt ſimple Glands. Ignorant Phyſicians often rejoice to find a Diſcharge of *Mucus* made by the Force of a ſtrong Purge, as if

if they had done a great Exploit, but which is contrary to the Laws of Health.

[3] The back of the Tongue is full of ſmall Eminences, which diſcharge a *Mucus* eſpecially near its Root, which is connected with the *Epiglottis*; it is alſo furniſhed with the *Foramen cæcum* and mucous *Cryptæ*, and the glandular Expanſion of *Vaterus* covering the Tongue, continually moiſtens it with a viſcid Humour; all which Plenty of *Mucus* is not continually diſcharged, but ſtagnates, till it is expreſſed for Uſe by the motion of the Tongue, which ſtrongly compreſſes the adjacent Parts in its Action.

[4] The *Mucus* of the Mouth is certainly of great Uſe to retain the Air mixed with it, by its Tenacity, that it may be tranſmitted together with the Aliment into the Stomach, and there prove the Author of various Changes in it; for this reaſon the *Mucus* has a particular degree of Viſcidity; were it leſs tenacious, it would not retain the Air; and were it more ſo, it would not at all part with the Air.

[5] We have in another place queſtion'd whether all Air is of itſelf naturally ponderous, which is not yet ſufficiently determined; but as for the Air which is mix'd with our Aliment, there is no doubt but that gravitates.

[6] Philoſophers have not yet ſufficiently explained nor accounted for the intimate Nature of this wonderful Property Elaſticity; it is evidently demonſtrated that the Air may be extremely compreſſed into a very ſmall Compaſs, and very much dilated into a great Space; when it is compreſſed it ſuſtains a very great Weight, which upon expanding it will throw off. But the moſt ſagacious Sir *Iſaac Newton* ſeems to have come the neareſt to Nature of any in this Affair, for he firſt demonſtrated

ſtrated that one Kind of the conſtituent and leaſt Particles of the Air are not elaſtic, nor do they perform any Action like what we ſee in the Air; but if two of theſe ærial Particles come ſo near each other as is determined by the Creator, they will repel each other; and if any Body obſtruct their free Receſſion, it will be then removed with a conſiderable Force; alſo that this repelling Force increaſes as the component Particles of the Air approach nearer to each other, becoming almoſt infinite at the Point of Contact; much in the ſame manner as Loadſtones, having their ſimilar Poles oppoſed to each other; as the South Pole of one to the South Pole of the other, they will repel each other with a conſiderable Force, the greater as they approach the nearer.

[7] The external Air, which encompaſſes the human Body, is always colder than the Body itſelf; but if it becomes equally hot with the Blood, it will be greatly rarified; and being received into the Mouth, will diſſipate, or break the ſmall Air Bubbles retained by the *Saliva*, *Mucus*, and Parts of the Aliment.

[8] Was the Spring of the Air to be always of the ſame Tenor, it would not produce many great Effects; but the cold Air which is received into the Mouth, and mixed with the Aliment, is afterwards expanded by the Heat of the Stomach. This Expanſion of Air by Heat is ſo ſenſible, that I have viſibly perceived the Liquor aſcend in the æreal Thermometer whenever any Perſon entered the Chamber in which that Inſtrument was ſuſpended; ſo that the Particles of Air contained in our Aliments are alternately contracted and dilated hereby, and the ſmall Veſicles which they compoſe are maintained as it were in a conſtant Syſtole and Diaſtole, performing various Impulſes by their Sides,

Sides, acting upon their containing *Mucus*, and the Parts of the Aliment which are contiguous; therefore the Particles of Air in their Aſcent will be beat down again, will be expanded in their Deſcent, and will be alſo inflected by their expanſion, ſo that the Aliment will ſuffer a perpetual Attrition, and put on the Nature of the Fluids, by which they are encompaſſed, or ſuffer a perfect Diſſolution, in ſuch a manner as is requiſite to convert them into Chyle in the Stomach. It is alſo evident, that the Food which has been well comminuted by Maſtication, is in a manner formed into a ſort of Chyle, for they are changed into a thick, white, uniform, and turbid Fluid; and its white Colour demonſtrates, that its oily Parts are intimately blended with its aqueous, ſomewhat like an Emulſion; whence it appears why Maſtication is ſo neceſſary to long Life, inſomuch that it was a Maxim among the Ancients, that he who did not chew his Food well hated his own Life; for the weak Attrition of the Stomach would not overcome the Coheſion of the Aliment, if it were not to be firſt well divided with a conſiderable Force by the Teeth, and aſſiſted by the Action of the Air and diluting *Saliva*, without which it would not be converted into good Chyle. But good Blood can never be made of bad Chyle; an exact Maſtication is therefore to be greatly recommended to every ſedentary Perſon, who leads an inactive Life, as is generally the Caſe with Men of Letters, who do not exert muſcular Motion to break the Aliment. Clowns and Labourers often omit Maſtication without any uneaſineſs or detriment. Lyons, Tygers, and other voracious Animals do not chew their Food, and yet they quickly grow hungry again even after a plentiful Meal; they digeſt indeed with a great Force, but they do not make any large Quantity of Chyle from their Food.

Food. And thus alſo a Man might digeſt his Food, which has been ſwallowed whole, without any great Inconvenience, if he has firſt faſted a conſiderable time before; the Acrimony of the *Saliva* in that Caſe ſupplying its want of Comminution by the Teeth.

§. 70. The Food thus divided by the Teeth, variouſly agitated in the Mouth, intimately mix'd and diſſolved by the *Saliva*, and lubricated with its *Mucus*, is there forced over the Tongue towards the *Fauces*, or poſterior Part of the Mouth. In this Operation all the ſolid or fluid Aliment is preſſed by the conjunct, or elſe ſucceſſive Action of the ſeveral Muſcles (§. 62.) belonging to the Lips and Cheeks, from without and betwixt the Teeth into the inner Cavity of the Mouth, formed by the concave Part of the Palate and the Space under the Tongue; the two Jaws are then preſſed cloſe to each other, and the Aliment lodged upon the concave Surface of the Tongue, which is at that time expanded by its ſix Muſcles, and afterwards preſſes itſelf cloſe againſt the Roof of the Mouth and upper Teeth, making its Preſſure backward ſucceſſively from one Tooth to another; and thus the Aliment is forced backwards from the Teeth by the Preſſure of the Tongue againſt the arched and furrowed Roof of the Palate, which is very conveniently formed to direct the Aliment towards the *Fauces* and Root of the Tongue, which performs this Motion by the ſucceſſive Action of its longitudinal Fibres, aſſiſted by its *Genioglossi*, *Styloglossi*,

Styloglossi, and *Ceratoglossi* Muscles; a Cavity is then immediately formed for the Reception of the Aliment at the Root of the Tongue, circumscribed above by the *Uvula*, *Velum* of the Palate, and the Tonsils; below by the *Larynx* and *Pharynx*, and behind by the Menbranes which connect the *Vertebræ* of the Neck, and invest the posterior Muscles of the *Pharynx*. The Tongue is next dilated, and its Root drawn forwards and upwards by the conjunct Action of its *Geniogloſſi*, *Myloglossi*, and *Styloglossi* Muscles, so as to come into Contact with all the upper Teeth; at the same time the *Velum* of the Palate is drawn right upwards, by the Contraction of the *Pterygostaphylini* Muscles, so as to shut up the Opening of the *Fauces* into the Nose; the *Rima* of the *Glottis* is also made narrower by its proper Muscles, the *Uvula* too is drawn downward and forward upon the *Glottis* by its *Azygos* Muscle, in such a manner, that with the Concurrence of the *Epiglottis*, all Communication is cut off between the Mouth and Lungs; and thus every Particle of the solid or fluid Aliment to be swallow'd, is convey'd into this Cavity of the *Fauces*, without any escaping into the *Larynx* and Nose.

There is not any one Function in the whole human Body so difficult to be understood and described as that of Deglutition; nor is this at all surprising, since of all the compound Actions in the Oeconomy this is the most complex; in this Action the Aliment ought first to be convey'd into the

Cavity of the *Fauces*; then the *Oeſophagus* ſhould be opened, and at the ſame time the Apertures which are near the *Oeſophagus*, and lead into the *Larynx* and Noſe, ſhould be both exactly cloſed; after this the Food ſhould ſlide in ſuch a manner over the cloſed *Rima* of the *Glottis*, and its covering Valve the *Epiglottis*, that no Particle of the Solid, nor the leaſt Drop of Fluid Aliment ſlip into the *Trachea*, which would even be ſufficient to cauſe Convulſions, and danger of Suffocation. In order therefore to obtain a clear Notion of this complex and obſcure Action, it will be neceſſary to divide its Hiſtory into Stages, and to trace the Aliment diſtinctly as it paſſes through the ſeveral Cavities appertaining to the Mouth. The firſt (1.) of theſe Cavities is that of the Cheeks or *Os externum*, which is terminated before by the Cheeks, and the meeting of the Lips above the middle of the Chin; behind by the meeting of the upper Jaw with the Bones of the Noſe on each Side, and by the middle of the lower Jaw. The next (2.) is a Cavity under the Tongue in the *Os internum*, continued from under its Lip, and on each Side to where the Membranes of the Mouth are continued to the Gums and lower Jaw. (3.) The Cavity above the Tongue, between its back and the concave Palate. (4.) The Cavity of the *Fauces*, ſeated behind the Root of the Tongue; which Capacity is much enlarged or dilated at the time of Deglutition: the Bounds thereof are the back of the Tongue, the Velum of the Palate (which is a membranous Expanſion continued pendulous backwards, towards the *Vertebræ* of the Neck, from the poſterior Margin of the Bones of the Palate, containing the *Uvula* in its middle) the *Iſthmia*, or Sides of the *Fauces*, deſcending from the back Part of each *Foramen Narium*, the Top of the *Larynx* below, and the

the Membranes which inveſt the *Vertebræ* of the Neck behind. — The Progreſs of the Aliment is from the two firſt of theſe Cavities into the third, and from thence in the fourth; the Mouth of the *Larynx* is then ſhut, and that of the *Pharynx* dilated; and then the Aliment paſſes over the *Epiglottis* into the *Fauces* and *Pharynx*, in order to deſcend to the Stomach. Now ſuppoſe yourſelf about to ſwallow an Ounce of Water, or a morſel of Bread, their Conveyance into the *Fauces* will be thus: 1. The Muſcles of the Lips and Cheeks being ſtrongly contracted, will ſuddenly protrude them to the Cavity above the Tongue; then, 2. the Tongue will be ſpread flat and hollow to receive them; and, 3. it will be preſſed ſucceſſively againſt the Palate, and ſo protrude the Aliment directed by its Sides into the then diluted *Fauces*, without any Part eſcaping. But the Aliment is then arrived no further towards Deglutition than the *Fauces*; it may therefore now be proper to deſcribe the Structure and Action of the *Pendulous Velum* of the Palate, with the other Parts of the *Fauces*, as they were by me explained ſome Years ago to my Hearers.

The Mouth being opened, the Tongue depreſſed, and the Light directed into the *Fauces*, we have then a View of its two anterior and lateral Columns, as alſo of its poſterior ones; and between theſe anterior and poſterior Columns appear the Tonſils on each ſide; the upper Part of theſe Columns are bent into two Arches, which meeting in the middle, form the *Uvula*; all which Parts being very moveable, the *Uvula* with the Arches are ſuſpended freely in the Air, and ſuſtained by their Fibres being faſtened to the poſterior Part of the arched Bones of the Palate. The conſtituent Parts are, the two Membranes, one inferior, looking

ing downward, and the other ſuperior, with its Surface upward; the lateral Membranes, which inveſt the Columns and Tonſils; alſo the mucous *Cryptæ*, or Drains throughout the whole Extent of theſe Membranes, eſpecially in the open circular Sinuſſes of the Tonſils betwixt the Columns; the *Uvula* alſo, furniſh'd with its mucous *Cryptæ*; with Veſſels of all Kinds; and various Muſcles included between the two Membranes.

The inferior and callous Integument of the Palate, which is thick, furrow'd and arched, concave toward the ſides, but riſing into a Ridge in the middle, is in that Part of a particular Texture, different from any other; it inveſts the concave Baſis of the two arched Bones of the upper Jaw, as alſo of the Bones of the Palate, upon which latter it becomes more ſoft, thin, and ſmooth; proceeding backward from the poſterior Margin of the arched Bones of the Palate, it forms the lowermoſt and external Coat of the *Velum Pendulum*, being perforated thro' all that Extent with the ſmall Outlets of the mucous Drains, being alſo connected laterally to the Membranes of the Mouth on each ſide the *Velum*.

The ſuperior, ſoft, thin and ſmooth Integument of the Palate, which inveſts the upper Surface of the Palate-bones next the Noſe, becomes ſtill thinner in its Progreſs backward from the poſterior Margin of the Arches of the Palate-bones, where it gives an external and upper Coat to the *Velum Pendulum*, every where perforated with the Emiſſaries of the mucous Drains, eſpecially towards the *Uvula*; it inveſts the ſuperior Parts of the *Velum*, and diſappears, by uniting itſelf into the lower Integument of the Palate, by which means they form one common Covering, which includes all the other Parts.

Between

Between the two Membranes which form this common Covering, are interſpers'd an infinite Number of ſmall Arteries and Veins, render'd very conſpicuous by Injecting, together with the Emiſſaries of the mucous Drains, the Tonſils, the mucous *Cryptæ*, or Drains themſelves, and the *Uvula*, with its various Muſcles and Veſſels.

The Tonſils are placed on each ſide, between the anterior and poſterior Columns of the Palate, being made up of the ſame mucous Integument, complicated into hollow Spires, in order to give a greater Extent of Surface for the numerous Emiſſaries of the mucous *Cryptæ*, that they might remain diſtinct and unobſtructed, to diſcharge their liquid *Mucus* at this Part; ſo that the Tonſils appear to be Bodies made up of mucous *Cryptæ*, the Veſſels which convey and ſeparate that mucous Fluid, and the Ducts which carry out and diſcharge the ſame, being all plac'd diſtinct in one Membrane, which is folded up by hollow Turnings and circular Windings; and that their *Mucus* might be more freely diſcharged at the time of Deglutition, we find the Tonſils are placed between the Muſcles of the Columns of the Palate; the mucous *Cryptæ*, which are alſo remarkable in ſome other Parts, are in none more large and numerous than in theſe.

The *Uvula* is of a conical Figure, and of a very ſmooth or ſlippery, flexible and ſub-pellucid Subſtance, full of the open mucous Drains, and furniſh'd with long muſcuar Fibres, terminating in a Point; and the Remainder of it is compoſed of an infinite Number of Veſſels wove together.

The numerous Veſſels of this Part are of almoſt all the Orders of Arteries and Veins, ſerving ſome for the common Circulation, and others chiefly for ſupplying the mucous *Cryptæ*.

The Muſcles for the motion of the moveable Palate have been moſt exactly deſcribed by *Fallopius*, *Valſalva*, *Morgagni*, and *Santorini*; from which celebrated Anatomiſts we ſhall here take our Deſcriptions of thoſe Muſcles, which ought to be recited, in order to underſtand their Actions, which we are now going to enumerate.

If the Mouth of a healthy Perſon be held open againſt the Light, and the back Part of the Tongue preſſed down, we have then an Opportunity of viewing the ſeveral Motions of the *Velum*, or moveable Palate; which is a thing that well deſerves to be obſerved and conſidered by us. For,

I. If the Perſon be not directed to any particular Action, but breathes freely in the uſual manner, the acute ſide of the connecting Membranes will appear, on each ſide of the back Part of the Tongue, a little before the *coronoide* Proceſſes of the lower Jaw, being continued and diſperſed into the *Velum*. Immediately behind theſe connecting Membranes, we meet with the two anterior Columns of the Palate, which ariſing upward on each ſide from the back Part of the Tongue, are inſerted into the *Velum*, where they make two narrow Arches, which uniting in the middle, form the *Uvula*. Behind theſe anterior we find the two poſterior Columns of the Palate, which reſembling the former, ariſe upward into the *Uvula* and preceding Arches, almoſt diſappearing in their fore Part. In a Space between the anterior and poſterior Columns are placed the Tonſils on each ſide. And the laſt Part which offers itſelf to View, is the back Part of the *Fauces*, ſpread upon the Front of the Bodies of the upper *Vertebræ* of the Neck, furniſh'd towards the bottom with very large mucous Drains, ſo conſpicuous as to reſemble little Ulcers.

II. If

II. If the Perſon then endeavours to blow out his Breath thro' his Mouth only, whilſt it remains wide open we ſhall then have an Opportunity of ſeeing, 1. The *Uvula*, hanging indeed pendulous, as before, but at the ſame time much more elongated, by being more ſtrongly and highly lifted up. 2. The *Velum*, or moveable Part of the Palate, will then be ſtrongly and ſuddenly elevated in its anterior Part; ſo that the before ſmall Curvatures of the Arches will now form Segments of much larger Circles, by which means the Arches will become much wider and more open. 3. The adjacent Parts, ſituated behind the preceding, being at the ſame time lifted upwards and forwards, become more conſpicuous, and appear to be archiform, like them, capable of being drawn backward and forward, and of reſting, ſo as to be eaſily diſtinguiſh'd. 4. Alſo the lateral Columns of the Palate will be elevated at the ſame time, and in the ſame Action. 5. The back Part of the *Fauces* becomes more expoſed to View in its upper Part, where it appears ſo beſet with *Mucus*, that the Ignorant being deceived with its whitiſh Hue, imagine the whole to be ulcerated. 6. All theſe appear the more evident, as the Air is more ſtrongly and ſwiftly drove exactly thro' the Mouth only; inſomuch that the Proſpect enlarges to near the lateral Openings of the *Euſtachian* Tubes. 7. The poſterior Cavities of the Noſe will be alſo ſhut, by the *Velum* being drawn upwards, and then preſſed forwards. 8. The Communication between the Mouth and Noſe will by that means ceaſe, becauſe the *Velum* acts the Part of a ſhutting Valve.

III. Theſe Appearances being duly obſerved, and the Parts yet remaining in their former Situation, let the Perſon endeavour to draw the Air quickly and ſtrongly thro' his Mouth only, not

any thro' his Noſe, the Parts all that while keeping the Situation before deſcribed II. By that means it will appear that Reſpiration may be performed barely by the Mouth only, notwithſtanding the Noſe being open in its anterior Part; therefore the Force which at that time preſſes the *Velum*, ſo as to prohibit the Air from paſſing into the Mouth thro' the Noſe, muſt be capable of reſiſting the Preſſure of the whole Atmoſphere.

IV. When all the preceding Obſervations have been carefully made, let the Perſon then ceaſe to breathe thro' his Mouth only, and alſo breathe thro' his Noſe; at that Inſtant all the Parts will be reſtored exactly to the State deſcribed at I. The *Uvula* deſcends, and becomes ſhorter, the Arches are let down, and become narrower, the poſterior Arches deſcend, and are cover'd more than before by the anterior ones, and all the adjacent Parts deſcend downwards, and are drawn more forward; the *Fauces* behind are more cover'd and conceal'd by them, the Cavities of the Noſe above the *Fauces* are render'd more capacious by the *Velum* deſcending forwards; and there is a free Communication reſtored between the Noſe, Mouth, *Fauces*, and Lungs; the Air may therefore paſs and repaſs all thoſe ways.

If then the Perſon tries to draw the Air only thro' his Noſe, and not at all thro' his Mouth, tho' it be held wide open, and the Tongue moderately depreſſed, there will then appear to the Obſerver, 1. The *Velum* of the Palate drawn downwards and forwards cloſe upon the back of the Baſis of the Tongue. 2. The two Columns of the Palate will be contracted downward, and cloſe to the Sides of the Baſis of the Tongue. 3. The poſterior Part or Baſis of the Tongue will be expanded towards the Columns on each ſide, and will riſe upward in a Curve,

a Curve, ſo as to come into Contact with the *Velum* of the Palate, and wholly intercept the Inſight to the *Fauces*. 4. The Sides of the Baſis of the Tongue will be very much expanded towards the Columns, and elevated to near the height of the middle of thoſe Columns. 5. The Paſſage for Air this way is by that means exactly cloſed, ſo that it cannot paſs in the leaſt, becauſe the ſtrict Approximation of the *Velum palati* againſt the Tongue, before the *Epiglottis*, is very viſible to the Eye; thus the Air, being ſtopt from paſſing this way into the Lungs, notwithſtanding the Mouth's being wide open, and the *Thorax* dilated, will endeavour to ſeparate the Parts now in Contact by the Preſſure of its whole Weight; ſo that the Force by which the Tongue and *Velum* are cloſed together muſt be very conſiderable. 6. The Air will then ruſh with a conſiderable *Impetus* thro' the Noſe and *Fauces* into the Lungs. 7. The lower Parts of the flexible *Alæ narium* will be contracted and preſſed inward, by which means the Noſe will become narrower and ſharper from the Preſſure of the ambient Air upon the external Surface of the Noſe, which is much broader than the open Space of the Paſſage thro' the Noſe; ſo that, 8. The Dilators of the Noſe muſt exert a conſiderable Force at that time, to ſuſtain the *Alæ*, and increaſe the *Foramina narium*, which would be otherways occluded by the Preſſure of the Atmoſphere; this will be ſenſible to any Perſon who obſerves this Experiment in another; ſo that in this Action there will be a Cavity form'd about the *Fauces*, not communicating with the Mouth, but opening into the Noſe, and having a free Paſſage for the external Air thro' their Cavity and the open *Glottis* into the Lungs, the Cavity being limited before by the Baſis of the Tongue, which is elevated at its Root, and alſo dilated there

towards each ſide; the *Velum* of the Palate is then preſſed cloſe to the Baſis of the Tongue, being at the ſame time contracted downward, and on each ſide upon the back of the Tongue; the Cavity thus formed behind the *Velum*, is limited below by the Baſis of the Tongue, behind which is the *Epiglottis*, with the *Larynx* and *Pharynx*.

VI. All theſe Appearances being carefully obſerved, let the Perſon be deſired to blow all his Breath ſtrongly and quickly thro' his Noſe only, without letting any Part eſcape thro' his Mouth; in which Caſe every Part will remain, and appear as we before deſcribed, except that the *Alæ* of the Noſe will not then be contracted, nor compreſſed by the Atmoſphere, but will be rather dilated, or thruſt outwards, and by that means be elevated. And theſe are the ſurpriſing, neceſſary, and moſt uſeful Actions performed by this acceſſary Organ of Deglutition. We have been the more particular in deſcribing theſe Appearances, that we may have a better Notion of the Action of the Muſcles belonging to this Part, which are exactly deſcribed by *Fallopius*, *Valſava*, *Morgagni*, and *Santorini*, as follows,

1. The *Thyro-Palatinus* of *Santorini*, which draws the anterior Part of the *Velum* forwards, downwards, and to each Side, and applies it to the Baſis of the Tongue, then elevated and expanded, expreſſes the *Mucus* of the Tonſils and of the other mucous Drains, at the ſame time they draw the *Uvula* downward and forward, make the Arches of the Palate flatter, and in the laſt Act of Deglutition they in ſome meaſure elevate the *thyroide* Cartilage and the *Larynx* towards the *Uvula*; they lubricate the external Surface of the Aliment with the proper *Mucus*, and then protrude it into the open Mouth of the *Pharynx*; they help to enlarge the Cavity of the

the *Fauces* in the foregoing Action, and ſeem to drive the *Larynx* a little outward as well as upward, and by that means to thruſt the *Glottis* under the Cavity of the *Epiglottis*, which is then thruſt backward.

2. The *Pharyngo-Palatinus* of *Santorini*, which draws the *Velum* backward, upward, and to each Side, and elevates the poſterior Part of the *Pharynx*, alſo preſſes the *Uvula* and *Velum* downward, in ſome meaſure elevates the adjacent Parts of the *Pharynx*, and applies it to the depreſſed *Velum*; it alſo in many reſpects conſpires to act together with the *Thyro-Palatinus*, as will appear from what was before ſaid of that Muſcle.

3. The *Gloſſo-Palatinus* of *Santorini*, which draws the anterior, lateral, and upper Parts of the *Velum* forward and downward, and preſſes it againſt the back of the Tongue, which is then elevated and expanded, at the ſame time preſſing out the *Mucus* from the Tonſils and adjacent Drains, it alſo depreſſes the *Uvula* downward and forward, and renders the Arches of the *Velum* flatter; elevates the lateral and poſterior Parts of the Tongue, and preſſes them againſt the *Velum* towards the laſt Part of Deglutition, alſo lubricating the external Surface of the Aliment; and then protruding the ſame into the open Mouth of the *Pharynx*, it alſo aſſiſts in forming the Cavity of the *Fauces* of the preceding Action.

4. The *Hypero-Pharyngæus* of *Santorini*, which by the Direction of its Fibres draws the *Velum* upwards ſtrongly and equally together with its Arches towards the poſterior Margin of the Bones of the Palate, ſo that when it acts with the Conjunction of the preceding Muſcles, it compreſſes and increaſes the Contact of the Tongue and *Velum*, it prevents the *Velum* in that Situation from being

moved forward towards the Mouth, or backwards towards the *Fauces*, by the Force of the Air, and therefore determines the Paſſage of the Aliment to the *Fauces* in Deglutition, and of the Air thro' the Noſe only in Expiration and Inſpiration.

If all theſe Muſcles act together, and concur with the Action of the Muſcles which elevate and expand the Baſis of the Tongue, they then make the *Velum* immoveable, either backward or forward, whilſt there remains a free Paſſage thro' the Noſe and open *Glottis*, in ſuch a manner that Reſpiration may be performed thro' the Noſe only, without any Air paſſing by the Mouth.

5. The *Spheno-pterygo-palatini* of *Cowper*, which dilate the back Part of the *Velum*, and expand it to each Side, at the ſame time they ſtrongly move it on each Side towards the Hooks of the internal Wings of the *Pterygoide* Proceſſes backward, and in ſome meaſure depreſs the ſame as by the Direction of a Pully, by which means they draw the *Velum* backward, ſo as to ſhut the *Foramina Narium* in that place, and direct the Aliment contained in the *Fauces* into the *Pharynx*, in the laſt Act of Deglutition.

6. The *Sphæno-palatini*, or *Spheno-ſtaphylini* of *Cowper*, which ſtrongly move the poſterior Part of the *Velum* backward, and ſomewhat obliquely upward, moving the *Uvula* together with it, they dilate and expand the *Velum*, and preſs it againſt the anterior Part of the firſt *Vertebra* of the Neck; they alſo ſtrongly and exactly ſhut up the poſterior Cavity of the *Foramina Narium* and prevent any Air from paſſing or repaſſing that way thro' the Noſe; ſo that they ſuſtain the whole Preſſure of the Atmoſphere, when the Air by its Weight ruſhes into and dilates the Lungs thro' the open Mouth and *Glottis*, they occlude the Openings of the *Euſta-*

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chian Tubes, and protrude the Aliment from thoſe Tubes in Deglutition; they alſo contract the Cavity of the *Fauces*, and prevent the Aliment from regurgitating out of the *Fauces* into the Noſe.

If one diligently inſpects the two laſt Pair of Muſcles acting together, the *Velum* of the Palate may be ſeen plainly ſtretch'd and expanded every way; being by that means enlarg'd, it becomes better fitted for cloſing the poſterior *Foramina* of the Noſe and Openings of the *Euſtachian* Tubes, and to protrude the Aliment in Deglutition down into the dilated Cavity of the *Pharynx*, at that time elevated, and to direct the Air and Voice thro' the Mouth only. But when all the four mentioned Muſcles act together in their various Directions, the Baſis of the Tongue muſt then be elevated, drawn back, and cloſely applied to the *Velum*, the *Epiglottis* will be exactly and every way adapted to the *Rima* of the *Glottis*, the *Velum* drawn up tight, will preſs againſt the Aliment to be ſwallowed, will be re-acted upon by the Baſis of the Tongue, *Larynx*, *Epiglottis*, and *Pharynx*; ſo that the Aliment will be preſſed backward into the Mouth of the *Pharynx*, at which time there will be a Cavity formed in the *Fauces*, then only communicating into the *Oeſophagus*; but when theſe Muſcles act ſucceſſively, and in various Combinations, the Air then ſuffers various Agitations, by the different Motions of the *Velum*, in its Paſſage through the Mouth and Noſe; by which, with the Vibration of the *Glottis*, and other membranous Parts, the Voice is modulated, varied, and articulated in Speech.

7. The *Azygos* of *Morgagni* draws the *Uvula* directly forward and downward, by which means it covers the poſterior Part of the *Glottis* behind the *Epiglottis*, which Part of the *Rima*, by the Elevation of the hollow *Apex* of the *Epiglottis*, is not exactly

actly closed in the last Part of Deglutition without this Assistance; by this means no Part of the Aliment is admitted to pass in Deglutition under the *Epiglottis*, or on either Side of the *Glottis*, but is all protruded into the open *Pharynx*, without leaving any Part behind; insomuch that fluid Aliments, which press every way, cannot insinuate betwixt the *Glottis*; for if after Deglutition a small Part of the solid or fluid Aliment should remain upon the *Rima* of the *Glottis*, or its smooth Sides, it would be carried thro' the *Rima* by the Air in Inspiration, and excite a most violent Cough, sometimes even to suffocation. When the *Uvula* is lost, it occasions that Disorder, but does not hurt the Voice. The *Uvula* is then of Service to the *Epiglottis*, and various other Uses; it stops out the grosser Particles which float in the Air we breathe, it licks up and stops the *Mucus* of the Tongue in its natural Descent towards the *Glottis*, and prevents it from being thrown upon the naked *Larynx* by the Tongue; it serves as an arched and slippery Bridge, exactly fitted every way to cover the convex Sides and *Rima* of the *Glottis*, for the Aliment to slide easily along in Deglutition; it prevents the Aliment from falling out of the *Fauces* into the *Larynx* in Deglutition; and being moved by its Muscles, protrudes the Aliment backward into the upper Part of the *Fauces*.

The Uses of the *Velum* of the Palate are, to serve as a Valve for opening and shutting the Cavity of the Nose into the Mouth, and to serve as a Partition or Valve betwixt the Cavities of the Mouth and Nose; to dilate the Cavity of the *Fauces* above, and contract it below; to depress the Aliment into the *Pharynx* in Deglutition, and to modulate the Voice, by directing its Tone thro' the Nose, Mouth, or both; and by the Assistance of the *Uvula*, to prevent the Aliment

Aliment from ſlipping into the Lungs in Deglutition; alſo to lubricate the Surface of the Aliment.

Thus we have deſcribed the Paſſage of the Aliment into the *Fauces* only, the *Pharynx* being as yet not opened: ſo that if a Perſon ſhould laugh, talk, or ſneeze at that time, the Aliment would regurgitate thro' the Noſe, or elſe ſlip into the *Larynx*, and excite a convulſive Cough. But to prevent thoſe Inconveniences, Nature has made good Proviſion.

At the time when the Aliment is convey'd into the *Fauces*, there is a conſiderable Cavity formed there for its Reception. This Cavity is limited before by the Tongue, applied to the Roof of the Mouth, and preſſed againſt the *Velum* of the Palate, which is alſo approximated by its proper Muſcles, (1, 2, 3, 4.) ſo as to come into Contact with the Sides of the *Fauces* and Arches of the Palate. It is limited behind by the *Vertebræ* of the Neck, lined with ſeveral Muſcles and Membranes, and lubricated with numerous ſmall mucous Glands. This Cavity is principally enlarged downwards, when the *Larynx*, *Os Hyoides*, and Tongue, are drawn ſtrongly upwards, while the *Pharynx* is relax'd, and the Aliment protruded into it. The *Cæphalo-pharyngei* Muſcles, undeſervedly rejected by the Moderns, do then elevate the *Pharynx*, and expand its membranous Coats. So that while the Bag form'd by the *Pharynx* is dilated backwards, its anterior Part is depreſſed, and its Sides elevated and expanded by the *Stylopharyngei*, and the muſcular Fibres which come from the *Os Sphenoides*; alſo the Parts which ſhut up the Cavity of the Noſe contribute to form this *Infundibulum* of the *Pharynx*. But the Paſſages to the Noſe and *Larynx* are to be at this time occluded, to prevent thoſe Parts from being offended by a Regurgitation of the Aliment.

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The *Foramina Narium* are cloſed by the *Velum* of the Palate, being elevated by the *Spheno-palatini* Muſcles, and by the *Spheno-pterygo-palatini*, which move the whole *Velum* upwards, and ſhut the poſterior Opening of the *Foramina Narium* with it like a Valve. —— But the *Glottis* is to be alſo cloſed at the ſame time; which is not done, as many imagine, by the *Epiglottis*; for that is ſomewhat erect, and not eaſily inverted, becauſe of its Connection with ſtrong Ligaments to the Sides of the Tongue; ſo that it cannot ſhut the *Glottis*, only prevent any thing from falling into it, in paſſing from the Baſis of the Tongue. The *Ary-arytænoidei* Muſcles do thus cloſe the *Glottis*, and ſo cloſely approximate the Sides of its *Rima*, that not ſo much as the leaſt Air can paſs thro'; the *Uvula* is then placed round the *Glottis*, behind the *Epiglottis*, by the Action of the *Azygos* Muſcle of *Morgagni*, by that means cloſing the *Glottis*, ſo that any adjacent Parts of the Aliment cannot fall into the *Larynx* with the Air in the next Inſpiration. There are ſome indeed who will not admit this Action to the *Uvula*; but it is apparently true from Obſervations in the Diſeaſes of the *Uvula*. For the *Uvula* being ſlit or deſtroy'd, neither injures the Voice nor Deglutition, only the Patient will be perplex'd with a Cough in ſwallowing, becauſe all the Aliment does not paſs clean over the *Glottis* (behind the *Epiglottis*) into the *Gula*, but ſome Part adhering about the *Rima*, is thrown into the *Larynx* in the next Inſpiration, where, by irritating the tender and ſenſible Membranes of the *Aſpera Arteria*, it will not fail to excite a convulſive Cough and Suffocation, if it be not happily ejected. Such was the Caſe of a *Daniſh* Nobleman, who endeavouring to return an Anſwer while he was ſwallowing a Mouthful of Meat, was ſuddenly ſtrangled; and upon opening his Body,

Body, the Morſel was found ſtuff'd in between the *Glottis*.

§. 71. Then the *Os Hyoides*, and Parts thereto connected, are ſtrongly drawn upwards and forwards by the Action of the *Geniogloſſi*, and ſometimes of the *Mylogloſſi*, or the lateral Fibres of the *Geniohyoidei* (which latter ariſing from the inſide of the Chin, under the *Geniogloſſi*, are inſerted about the ſmall cartilagenous Horns of the *Os Hyoides*; alſo by the Action of the *Mylohyoidei*, which ariſing with a broad Tendon from the middle of the Baſis of the *Os Hyoides*, is afterwards inſerted by a large *Aponeuroſis* into the lower Jaw, from the grinding Teeth too near the middle of the Chin, poſſeſſing all the Space betwixt the inſides of the lower Jaw and *Os Hyoides*, they draw the *Os Hyoides* in all Directions towards the lower Jaw, and to each Side; they draw that Bone upwards and forwards, and elevate all the Parts connected to and upon it, as the Tongue, *&c.* alſo by the *Stylocerato-hyoidei*, which ariſe ſharp and fleſhy, from the *Styloide* Proceſſes of the *Oſſa Temporalia*, and deſcending obliquely forwards, they are generally perforated by the Digaſtrics, (§. 60.) are inſerted into the Articulation of the greater Horn with the *Os Hyoides*, and its Baſis, and ſerve to draw the *Os Hyoides*, with all connected to it, upwards and backwards;) the Baſis of the Tongue is alſo expanded, elevated, and drawn forwards; the *Os Hyoides* is preſſed up againſt the moveable Palate, the Paſſage to the Noſtrils is by that means

means ſhut with the *Velum*, and the *Os Hyoides* and *Larynx* are approximated cloſe to each other in their Elevation, by the Contraction of the *Thyro-hyoidei* (which ariſe fleſhy from the Side of the *Os Hyoides*; and deſcending, are inſerted by a large expanſion into the ſcutiform Cartilage, and continued to the lower and lateral Margin of the ſame:) The Parts thus elevated, preſs back upon the Aliment to be ſwallow'd, and by that means keep down the *Epiglottis* from riſing, which together with the *Uvula*, being preſſed by its proper Muſcles upon the *Rima* of the *Glottis*, cloſe up the Aperture which admits the Air in Inſpiration; they likewiſe ſpread upon the Surface of the Aliment a lubricating *Mucus*, preſſed out of the *Velum* of the Palate, *Uvula*, Tonſils, Root of the Tongue, the *Epiglottis*, and its Glands, with the *Glandulæ arytænoidææ*, and mucous Drains of the *Pharynx*, much facilitating the Deglutition of the Aliment; the elevated and expanded Root of the Tongue, with the *Os Hyoides* and *Larynx*, are then drawn forwards by the *Geniogloſſi*, *Mylogloſſi*, *Genio-hyoidei* and *Mylo-hyoidei* Muſcles, which by that means ſufficiently dilate the *Fauces* and *Pharynx*, connected to the Root of the Tongue, *Os Hyoides* and *Larynx*, ſo far as to make room for the Aliment to be ſwallowed, eſpecially when the external *Pterygoidei* and ſome Fibres of the *Maſſeter* Muſcles violently draw the whole lower Jaw forwards, by which means the Cavity is much enlarged, while the *Gloſſo-pharyn-*

gæi,

gæi, *Hyo-pharyngæi*, *Thyro-pharyngæi*, and *Crico-pharyngæi* Muſcles diſtract and dilate the *Pharynx*, by drawing it forwards, and to each Side; and thus the Aliment is convey'd into the dilated upper Part of the *Pharynx* to be ſwallow'd, the Aperture of the *Larynx* is cloſed, the *Oeſophagus* is then relax'd, the *Stylo-pharyngei* contracted, and conſequently the Aliment preſſed into the upper Part of the *Gula*. But at the ſame time the *Pharynx* is dilated, the *Velum* of the Palate is alſo expanded and elevated by its proper external and internal Muſcles, which cloſe up the poſterior *Foramina* of the Noſe, direct the *Uvula*, and ſo prevent any Regurgitation of the Aliment into the Noſe and *Glottis*.

§. 72. The very Inſtant after theſe Actions have been performed, all the Muſcles (§. 71.) which were then contracted, are now relaxed, and both the *Sterno-hyoidei* begin to act (which ariſing fleſhy from the inſide of the Clavicles, near the *Sternum*, and adjoining *Sternum* itſelf, aſcend ſtrait upward to their Inſertion at the anterior Part of the Baſis of the *Os hyoides)* and at the ſame time the *Sterno-thyroidei* are contracted (which ariſing from the upper and outer Margin of the *Sternum* and Clavicles, aſcend to the Baſis of the ſcutiform Cartilage, to which they are connected, and are inſerted obliquely outwards into the lateral and external Tubercles of the ſame Cartilage) together with the *Coraco-hyoidei* on each ſide (which ariſing round and fleſhy from the upper *Coſtæ*

of the *Scapula* at the Root of the *coracoide* Proceſs, forms a digaſtric Muſcle in its Progreſs, and is inſerted into the anterior Part of the *Os hyoides*) by which Mechaniſm the broad and back Part of the *cricoide* Cartilage is preſſed backwards and downwards againſt the *Pharynx*; at the ſame time the depreſſing Muſcles of the Palate are contracted with a great Force, and an almoſt convulſive Celerity (the *Gloſſo-ſtaphylini*, *Pharyngo-ſtaphylini*, and *Azygos* of *Morgagni*) whereby the *Velum* of the Palate, then expanded and drawn tight upwards, is now pull'd down, and protrudes the Aliment in the *Fauces* into the Mouth of the *Pharynx*, now elevated and dilated, the *Gloſſo-ſtaphylini* and *Pharyngo-ſtaphylini* being at the ſame time contracted; then the *Gloſſo-pharyngei*, *Hyopharyngei*, and *Thyropharyngei* are contracted with a convulſive motion, like the former, by which the Tongue, *Os hyoides*, *Larynx*, and back Part of the *Pharynx*, are preſſed together, and protrude the Aliment forcibly into the Mouth of the *Oeſophagus*; thus the *Pharynx* is cloſed, and the *Oeſophagus* contracted at the ſame time; the former of which ariſes from each ſide of the *coracoide* Cartilage, and embraces or externally inveſts the Mouth of the *Oeſophagus*; and thus the Aliment preſſed down in Deglutition, will reſide in the Cavity of the *Oeſophagus*, under the *Pharynx*. Thus operoſe or laborious is the Buſineſs of Deglutition, which requires the Concurrence of ſo many Organs and their Actions, which

muſt

muſt conſequently render this Function ſubject to various Accidents and Diſeaſes; but from a Conſideration of the Structure and Action of the ſeveral Parts concerned, we may readily underſtand why dry Food is *ſo difficult to ſwallow*[2], the *Saliva* and *Mucus* of the *Fauces* being not ſufficient to mollify and lubricate it; alſo why upon a loſs of the *Uvula*, a Perſon is troubled with a Convulſive Cough, and threatned with Suffocation in ſwallowing his Aliment; and laſtly, why the Aliment regurgitates into the Noſe in ſwallowing when the *Velum* of *the Palate is divided*[3]? Whence alſo it appears that the moveable *Velum* of the Palate performs the Office of a ſhutting Valve with reſpect to the Noſe, and of a depreſſing Muſcle with regard to the *Pharynx*.

The Morſule of Aliment is now convey'd into the *Fauces*, the Apertures of the Noſe and *Glottis* being cloſed, and the *Pharynx* dilated, to make ſufficient room for the Food in Deglutition; it therefore now remains for it to be protruded into and thro' the *Gula*, which is the laſt Buſineſs of Deglutition; in order to this, the *Pharynx* muſt be contracted in its Diameter by the *Sterno-hyoidei*, *Sterno-thyroidei* and *Coracoidei*, which draw the *Larynx* downward, and preſs it in ſuch a manner againſt the *Pharynx*, as to ſtraiten the *Gula*, eſpecially as the muſcular Fibres (which ariſe from the *Larynx* and *Pharynx*, and are interwove with the *Hyopharingei*, *Thyropharingei*, and *Circopharingei*) contract the Capacity of the *Pharynx*, while the *Velum* of the Palate, being preſſed down by its proper Muſcles, protrudes the Aliment into the

Gula, where, by the Contraction of the muſcular Fibres of the *Oeſophagus*, it is further protruded down into the Stomach; all the Muſcles therefore which before elevated the *Pharynx*, *Larynx*, and *Os Hyoides*, will be now relaxed, and only the *Rima* of the *Glottis* remain cloſed, by the Approximation of the *arytenoide* Cartilages by their proper Muſcles, in ſuch a manner, that no Liquor can paſs into the *Larynx* as it deſcends thro' the *Pharynx*.

[2] A Perſon cannot ſwallow a piece of dry Bread, when the *Saliva* and *Mucus* of the *Fauces* have been before exhauſted by eating of Bread and boiled Meat, except the *Gula* be moiſtened with Drink; for the exquiſite Senſation of the fine Membranes which line the *Fauces* and *Pharynx*, being offended by the Roughneſs of dry Food, will not admit, but exclude the ſame, as hurtful.

[3] The *Velum* of the Palate is ſometimes divided in venereal Ulcers, and the Fiſſure being dilated by the Preſſure of the Aliment, admits it into the Noſe; which Diſorder is incurable, and cannot be remedied by a Plate of Metal, as may an Eroſion of the Bones of the Palate; the afflicted Patient is therefore obliged to preſs the Aliment down to the bottom of the *Fauces* with his Fingers, leaning his Head backward, unleſs he had rather ſuffer it to regurgitate into his Noſe. I once ſaw a Child, who being born with a divided *Uvula*, could not ſwallow; upon opening the Mouth of the Infant, the *Uvula* appeared to be divided; and upon ordering it to ſhut its Noſe when it ſwallowed, the Aliment deſcended without offending that Organ; this ſame Child learned to ſpeak, but was obliged to ſhut his Noſe with his Hand at that time.

§. 73. The *Gula* or *Oeſophagus* is a diſtractile Tube, compoſed of ſeveral Membranes or Coats inveſting each other; the firſt and innermoſt of theſe Coats is *villous*[1] or downy, furniſhed with many nervous Papillæ, lines the whole internal Surface of the Tube, and continually affords a Liquor ſomewhat thicker and more *oily*[2] than the *Saliva*, which is ſeparated and diſtils down from the ſmall Twigs of the Arteries, diſtributed through the *Oeſophagus*, and ſerves to lubricate the Paſſage for Deglutition, renders its Fibres ſupple, and fit for Motion, and defends them from the Roughneſs of the Aliment. The ſecond Coat, which inveſts the former, is *glandular*[3], or rather full of *Cryptæ*, or Drains, which ſeparate and diſcharge the forementioned Liquor into the Cavity of the Tube; the other ſide of this Coat conſiſts of many ſmall Veſſels, which ſupply Blood to the forementioned Glands or *Cryptæ*. This glandular and vaſcular Coat is inveſted by a muſcular one, conſiſting internally of orbicular, and not *ſpiral*[4] *Fibres*, which are encompaſſed externally by longitudinal Fibres; all theſe are again included in a thin *cellular Membrane*[5], conſiſting alſo of Fibres and ſmall Veſſels, upon the back part of which are frequently placed *two ſmall Glands*[6] on the outſide of the Tube, about the fifth *Vertebra* of the *Thorax*, which prepare a mucous Juice, ſerving to lubricate this Tube.

[1] A piece of the *Oeſophagus* being turned inſide out, and ſuſpended in Water, in order to obſerve the internal Structure of this Coat, it appears villous or downy, like Velvet; but theſe *Villi* are nothing more than exhaling Arteries, which tranſmit the Injection of *Ruyſch* like little Worms; the ſame kind of *Villi* being alſo found in the Stomach and Inteſtines, they diſcharge a ſalival Fluid which does not coagulate by Heat; between theſe *Villi* are interſperſed many nervous *Papillæ*, whence proceeds the exquiſite Senſe we obſerve in the *Oeſophagus*; theſe *Papillæ* are pendulous to a great length in a Tortoiſe, their Baſis being upwards, towards the Mouth, their *Apex* towards the Stomach; it was neceſſary that the *Oeſophagus* ſhould have an exquiſite Senſe, to receive or reject the Aliment. I ſaw a Lad who ſuddenly clapt a hot Turnep into his Mouth, which had juſt been taken out of the Pot by his Mother, and then ſwallowed it; as ſoon as the Turnep had reach'd the Stomach, the Child preſently dy'd in the utmoſt Miſery.

[2] This Liquor is of a middle Conſiſtence, between the *Mucus* of the *Fauces* and that of the Lungs; it may be ſeparated by ſcraping the internal Membrane of the *Oeſophagus* after Death, and may be again preſſed out by ſcraping a ſecond time.

[3] In this glandular Membrane are numerous *Cryptæ*, or mucous Drains, called by *Duverney* lenticular *Follicules*, leſs than the Eggs of Silkworms, and like little Bladders, opening each with a large Orifice into the Cavity of the *Oeſophagus*, which diſcharge their mucous Liquor, ſeparated from their Arteries, and retained till preſſed out in Deglutition; to which Action it is ſo neceſſary, that we can ſcarce ſwallow any thing when that lubricating *Mucus* is wanting. From an Obſtruction of theſe ſmall Glands ariſes a *Schirrus*, and a difficulty

difficulty in ſwallowing, which gradually increaſes more and more, and is a Caſe that has frequently occurred in my Practice; the only Difficulty they have in ſwallowing, is from the Pain and Reſiſtance of the Aliment in its Deſcent. *Ruyſch* cured a Diſorder of this kind by a mercurial Salivation. This Diſeaſe ſeems to ariſe from the indulging of ſpirituous Liquors, and Drinks made very hot, which are now more in Uſe than they were with our Anceſtors.

[4] In Brutes, who have their Necks pendulous, the *Gula* is furniſhed with two Orders of ſtrong ſpiral Fibres, to make the Aliment which they ſwallow aſcend; and theſe Animals never vomit, nor can Deglutition in the human Subject be explained by the Structure of this Part in them; as the Aliment in Deglutition deſcends perpendicularly in the human Body, it may be ſwallow'd with a leſs Force, capable of being exerted by circular Fibres; but no one ought to deny theſe Fibres to be muſcular becauſe they look pale, for the Colour of every Muſcle is of itſelf white, its Redneſs proceeding from the Blood; nor is the *Oeſophagus* paſſive, ſo as to perform the Office barely of a Tube to the deſcending Aliment; but its Fibres being ſtrongly contracted on every ſide, protrude the ſame into the Stomach; but theſe Fibres act ſucceſſively one after another, the Contraction beginning at top, and deſcending gradually to the bottom; nor has the Weight of the Aliment any conſiderable Share in this Action, for Poſture-maſters drink with their Heads downwards, and cauſe the Drink to aſcend, contrary to the Force of Gravity.

[5] The external Membrane is that which ſerves as a *Stratum*, for the Paſſage of the Arteries and Veins which are diſtributed to this Part; for the

Veins and Arteries are diſtributed freely in no Part, wherein they do not communicate with their proper reticular Cells, in whoſe Cavities they diſcharge a lubricating Oil.

[6] Theſe two Glands are commonly called *Dorſales*, *Verſellonius* having deſcribed their excretory Ducts; but no Body has yet been able to diſcover them after him.

§. 74. The lubricated Aliment is therefore preſſed thro' the ſlippery and dilated *Oeſophagus*, by the Contraction of its *longitudinal and orbicular Fibres*[1]; which at laſt protrude it thro' the broad Mouth of the Stomach, then open and relax'd, into its Cavity.

[1] Theſe longitudinal Fibres dilate the *Gula*, ſhorten it, and approximate it towards the Aliment, to be ſwallow'd, while the orbicular Fibres contract it in diameter, and acting ſucceſſively downwards from the upper Part of the *Gula*, they protrude the Aliment into the Stomach.

§. 75. The Aliment being thus convey'd into the Stomach, the Mouth of that Organ and the *Gula* are naturally cloſed, eſpecially in Inſpiration, by a thick *fleſhy Muſcle*[1], riſing above and below the Level, in the middle of the *Diaphragm*, through which the *Gula* is tranſmitted, and attach'd thereto by muſcular Fibres; by which means the Contents of the Stomach are prevented from being preſſed again into the *Gula*.

[1] The *Oeſophagus* does not perforate the tendinous, but fleſhy Part of the *Diaphragm*, leſt if

there was an open Paſſage, the Aliment might again regurgitate out of the Stomach into the *Gula*, by the Preſſure of the *Diaphragm* in Inſpiration; but thus the Mouth of the Stomach is cloſed, at the ſame time and by the ſame Power which depreſſes it, when we breathe-in the Air.

We have now therefore a clear View of the Uſes of the *Oeſophagus*, and of the ſeveral Parts connected to it above. In ſhort, Deglutition conſiſts (1.) In a Protruſion of the Aliment into the *Fauces* by the Muſcles of the Tongue. (2.) In a Depreſſure of it into and thro' the *Pharynx* (while the Apertures of the Noſe and *Larynx* are ſtrictly cloſed) by the Muſcles of the *Velum*, Tongue, *Os hyoides*, *Larynx* and *Pharynx*. And (3.) In a Propulſion of it thro' the *Oeſophagus* into the Stomach, by the Contraction of its muſcular Fibres, which is alſo facilitated in its Paſſage by the lubricating *Mucus* of the Glands. — Diſeaſes of the *Oeſophagus* generally proceed either from a Tumour of the adjacent Glands, or from a Coheſion of its Sides. I have ſeen a Tumour of the Parotids which totally obſtructed the Action of Deglutition; and *Ruyſch* deſcribes another Caſe of this kind from the *glandulæ dorſales* being indurated and ſcirrhous, which would only yield to a Cure by the Power of a mercurial Salivation; the *Oeſophagus* coheres together, when all the oily *Mucus* has been before exhauſted from its cellular Texture by long faſting or fainting, in which Caſe Deglutition is ſuppreſſed; a miſerable Inſtance of which has occurr'd to my own Obſervation. If it ſhould be aſk'd how it comes about that Liquors are ſometimes more difficultly ſwallowed than Solids? the Anſwer is, that the Muſcles of the *Pharynx* being at that time paralytic and collapſed, the Solid has a greater Reſiſtance to open the ſame; but then again,

Fluids are ſometimes more eaſily ſwallowed than Solids, when the Capacity of the *Gula* is ſtraiten'd by an Inflammation, or otherways.

Concerning the Action of the Stomach *in digeſting the Aliments.*

THE Error of moſt who have endeavour'd to explain Digeſtion, has lain in their attributing that Function to only one or fewer Cauſes than are concern'd therein, excluding the reſt. To avoid falling into the like Error, we ſhall conſider the Stomach, 1. As a moiſt, warm, and cloſe Veſſel, in which the Aliment is receiv'd and retain'd (§. 76.) 2. As it is an Organ, ſupplied with ſeveral Humours, for the Diſſolution of the Aliment (§. 77, and 78.) 3. As it acts upon the Food, by the Contraction of its own muſcular Coat (§. 81.) And laſtly, 4. As it receives an external Force and Preſſure from the adjacent *Aorta*, *Diaphragm*, and abdominal Muſcles; from the Concurrence of all which very different Cauſes, the Function of the Stomach is perform'd, and ought to be explain'd.

§. 76. The ſolid and fluid Aliment thus ſwallow'd, before diluted with the *Saliva*, mix'd with the Air, and now received into the *cloſe*[1], moiſt, and *warm*[2], Stomach, does there quickly begin of its own accord to ferment, or *putrify*[3]; according to the different Nature of the *Aliment*[4] or Diſpoſition of the Stomach; and is eitherway wonderfully changed into an *aſceſcent*[5], *alcaleſcent*[6], *rancid*[7], or *glutinous*[8] Maſs.

[1] The

[1] The opening of Animals alive, and the Ructus's which aſcend a few Hours after a Meal, demonſtrate that the Aliment ſtays ſome time in the Stomach; therefore the Food will in this reſpect ſuffer the ſame Changes in the Stomach, which it would have undergone by ſtanding in a clean glaſs Veſſel, mixed with the *Saliva*, in a warm Place; it muſt be indeed confeſſed, that the Drink, and ſome of the more fluid Parts of the Aliment, paſs quickly thro' the Stomach, but the more ſolid are retained a conſiderable time.

[2] The Heat of the Stomach may not only be eaſily render'd conſpicuous by the Thermometer, but alſo ſenſible to the Hand thruſt into the Belly of an Animal when expiring. This Heat of the Stomach is in a great meaſure communicated and heighten'd by its Contact with the warmeſt Viſcera; the Heart lies upon the *Diaphragm*, immediately above it; the Liver inveſts it before, and on the Right-ſide, the Spleen on the Left, the *Aorta* behind, and the *Pancreas* with the ſplenic, cœliac, and meſenteric Blood-veſſels at bottom; the whole *Abdomen* alſo conſtantly adminiſters the Heat of a Bath to it. But that Heat which exceeds Warmth by a few Degrees, is of all the moſt efficacious in changing the Aliment; even Water ſo putrifies by the Heat under the Tropics, as to emit inflammable Vapours. The Heat of every Animal is always greater than that of the Air in which it lives, nor can any Creature live when its Blood is reduced to the ſame degree of Cold with that of the Atmoſphere; for the Heat of our Air never riſes to 90 Degrees, which is almoſt the perpetual Degree of Heat in the Blood of living Animals; therefore the Heat by which the Aliment is attenuated in the Stomach, muſt be nearly the ſame with that under the Tropics, which ſpoils the neat-

eſt Wines or the beſt Ale. But all Vegetables grow and digeſt their Aliment with a much leſs Heat, which Dr. *Grew* has ſhewn to be about 50 and 60 Degrees; for that diligent Naturaliſt and Phyſician made Tables containing the Heat of every Day for many Years, the Medium of which was as we have now mentioned.

§ The general Error of Writers on Digeſtion has been, their conſidering but one ſort of Change in the Aliment, as if we had never taken but one kind of Food; whence ſome will have the Diſſolution of the Aliment to be made wholly by Fermentation, and others barely by Putrifaction; both having ſome, but not the whole Truth on their ſide; for ſometimes neither Fermentation nor Putrifaction are perfectly preſent in Digeſtion. The fleſhy Parts of Animals and ſome Vegetables are naturally diſpoſed to Putrifaction, while Milk, the generality of Plants, and all Garden Fruits, are inclined to turn ſowr. Nor are thoſe to be confided in, who utterly deny Fermentation to have any Share in Digeſtion; ſuch ought to conſider, that the Stomach adminiſters the ſame Heat and Moiſture, as if farinaceous Aliment was mixed with four times as much Water, and ſet in a digeſting Heat, which would certainly turn it ſowr; nor can any Reaſon be given why the Stomach ſhould not make the ſame Change therein, tho' it may be not ſo ſoon, or to ſo great a degree, thro' its Agitation, or a Mixture of the Bile. That a ſimilar Fermentation is often perform'd in the Stomach, may appear from the flatulent Diſtention of that Organ, attended with Gripes and acid Ructus's, after eating of Garden Fruits; for as Fermentation is obſerved to be the generating Cauſe of this elaſtic Air in ſimilar Subſtances out of the Stomach, the ſame Phænomena muſt ariſe from the

the ſame Cauſe within the Stomach; but then this Fermentation is not carried to Perfection in the Stomach, ſince that would require the Aliment to ſtand at leaſt four or five Days therein, whereas it does not uſually ſtay above five or ſix Hours upon the Stomach; add, that Mixture in ſeveral Kinds of Aliments often prevents thoſe Changes uſually wrought by Fermentation or Putrifaction. Thus Milk will in a hot Summer turn ſowr in the Space of twelve Hours, and Blood will putrify in that time, if both are expoſed to the common Air; but when mixed together, the Mixture neither turns ſowr nor putrid, thro' the Reſtraint of their degenerating by their oppoſite Subſtance and Tendencies.

[4] All the fleſhy Parts, and the ſeveral Humours of Animals, except the Milk of Cattle feeding upon Herbs, do naturally putrify of themſelves, and will certainly do ſo in the human Stomach, if thoſe Powers are abſent which reſiſt Putrifaction; even all Sorts of Plants which come under the *tetrapetalous* and *ſiliquoſe* Kind, putrify with a cadaverous Stench, and afford a volatile Alcaly. Theſe Appearances greatly favour the ancient Hypotheſis of *Pliſtonicus*, or Digeſtion by Putrifaction, revived by *Liſter*.

[5] The whole Claſs of Vegetables, except a few of the aromatic and antiſcorbutic Plants, turn ſowr in a warm and moiſt Air, affording a volatile Acid; even the ſweet Meal of Oats, mixed with taſteleſs Water, turns extremely ſowr in a warm Place; and Muſt, or new Wine, alſo turns ſowr and corroding barely with Heat.

[6] By turning *alcaleſcent*, we mean, to approach the Nature of a lixivious Salt, produced by Fire; being *acrimonious*, of an urinous Smell, fermenting with Acids and tinging Syrup of Violets of a green Colour.

Colour. But lixivious or alcaline Salts are of two Kinds, 1. *Fixed*, being made from the calcined Aſhes of all green Vegetables, which diſſolved in Water affords a lixivious Salt. Even the ſowr *Wood-ſorrel* affords Aſhes by Fire, from whence may be made a Lixivium, perfectly endued with all the Properties of an alcaline Salt. The other ſecond Kind of this Salt is volatile, obtainable by Diſtillation from all the Parts of Animals or putrified Vegetables; in which Operation Part of the aſcending Vapours are turn'd into volatile Cryſtals, of a fœtid, urinous Smell, and fiery Taſte.

[7] All Oils grow rank when taken in a large Quantity upon a weak Stomach, to which State they have a natural Tendence, putting on the Quality of a rotten Egg. If a Perſon ſhould eat a good deal of freſh Butter that has been fry'd, without drinking a ſufficient Quantity of ſome aceſcent Liquor, it turns into a putrid, acrimonious Liquid, much of the ſame kind with the greeniſh Cruſt which is ſpread over Butter that has been long expoſed to a warm Air, being ſo extremely rank, that it leaves an intolerable Guſt for above an Hour after it has been taſted. From this Liquid ſtagnating in the Stomach there aſcends ardent and bitter Ructus's, and an inflammable Matter regurgitates into the Mouth, which was frequently by the Ancients miſtakenly called Bile. The like putrid Subſtance may alſo ariſe from ruſty Bacon or Lard, ſtale Eggs, oily Fiſh, *&c.* But that it is improperly called Bile, will appear from its flaming like Oil in the Fire, whereas Bile being caſt upon the Fire, extinguiſhes it; nor is this eaſily produced in ſtrong and bilious Habits, but rather in weak and hypochondriacal People, where the Bile is inactive.

[8] Not

[8] Not only glutinous, but ropy, drawing out into long Threads, and difficultly miſcible with Water; like what is made by boiling the Feet, Skin and Tendons of Animals in Water, and known by the Name of *Glue*. A Subſtance alſo of the like kind, but not ſo firm and ropy, may be made from Meal boiled with ſo ſmall a Quantity of Water that it will not turn ſowr, called Paſte.

§. 77. The internal *Coat* [1] of the Stomach embracing the Aliment, is *villous* [2] or downy, full of nervous *Papillæ*, ſmall quadrangular Cells, *Wrinkles* [3], Pores, and *tubuli*, which latter keeps it *moiſt* [4] and clammy; but the convex Part of the Stomach is furniſh'd with a Variety of numerous ſmall *Glands* [5], ariſing from and adhering to the vaſcular Coat, which receives Arteries from the *Epigaſtrics* [6], and three other Branches, all from the cœliac Artery, each of whoſe ſmall Branches being ſpent in a particular Diſpoſition, at laſt ſend off ſmall Twigs opening into the very Cavity of the Stomach, which is alſo very plentifully furniſhed with ſmall *Veins* [7] and *Nerves* [8], ſurpriſingly interwove with each other. This vaſcular Intertexture therefore ſupplies the Stomach with minute, pulpy, and ſucculent Emiſſaries, diſpoſed in little Heaps, of a glandular, oval, or globular Figure, whence continually diſtils a thin, pellucid, and frothy *Liquor* [9] into its Cavity, *ſpiritous* [10], and a little *ſaline* [11], being neither *acid* [12] nor *alcaline* [13] in the moſt *voracious Animals* [14], but *ſharp* [15] and ſcowering in ſuch

ſuch as have faſted long, being ſecerned into the Stomach by ſmall Ducts ſtriking off from the gaſtric *Arteriolæ*; beſides which Liquor the Stomach is alſo lined with a thick *Mucus*, ſeparated by ſmall Glands, collected and retained in their *Cells*[16], and afterwards expreſſed thro' proper Emiſſaries into the Cavity of the Stomach. The muſcular Coat of the Stomach contracting as it empties, forms its preceding vaſcular and villous Lining into large *Wrinkles*[17], that are wonderfully waved in and out, and again ſubdivided into leſs, which, together with the ſmall *quadrangular Cells*[18], prevent the groſſer Part of the Aliment from a too quick Paſſage; alſo retain ſome ſmall Part, which becomes acrimonious by *fermenting*[19], and by this, with *Attrition*[20] againſt each other, excite to hunger. Thoſe Animals whoſe Stomachs are not furniſh'd with the foremention'd internal Coat and its Liquors, are uſually ſupplied with them in the *Crop*[21] or firſt Stomach, or elſe at the lower Mouth of the *Gula*, next the Stomach.

[1] Being the ſame with, and a Continuation of, the villous Membrane of the *Oeſophagus*; being eaſily ſeparable in the Maw of a Hog, when it has been inverted and dipt in ſcalding Water.

[2] Conſiſting of *Vaginulæ*, or ſmall membranous Ducts, which direct the Courſe of and communicate with the ſmalleſt exhaling Arteries, and inhaling or abſorbing Veins, thro' both which kinds of Veſſels the ceraceous Injection frequently paſſes thro' into the Cavity of the Stomach, but without any Colour or Part of the Vermilion; which Experiment

periment happened to be made by *Ruyſch* about 35 Years ago, when he was endeavouring to accurately fill the Veſſels of the Stomach with his Injection; the Blood ſometimes eſcaping thro' theſe ſmall Arteries, occaſions bloody Vomits in plethoric Virgins, whoſe *Menſes* being obſtructed below, ſeek to be vented upwards.

[3] In a healthy living Man it is wrinkled; but in the dead Subject, whoſe Parts are relaxed, they are not ſo conſpicuous, being fewer, more extenuated, and unequal. Theſe *Rugæ* are formed in the villous Coat of the Stomach, becauſe that is not elaſtic; and the more it is filled, there are the fewer *Rugæ*.

[4] If the Stomach of a living Dog be opened, you will find the internal Surface of it lubricated; and if the *Mucus* be abraded, it will preſently be again renewed from the numerous ſmall Pores: this Liquor is of the ſame nature with the *Saliva*, and wholly evaporates upon the Fire, without leaving any *Reſiduum*.

[5] Some had rather call them *Cryptæ*, after *Ruyſch*, than Glands, being lenticular Cells, which diſcharge their *Mucus* at a proper time, to moiſten the internal Cavity of the Stomach.

[6] Moſt of the Viſcera have but one arterial Trunk, which enters its *Viſcus* in but one certain Part; yet we ſee the Stomach has four diſtinct Arteries, which enter it in as many different Places; it ſeems to have this particular Structure, that the Circulation might not be interrupted, when one Artery is compreſſed in the Stomach diſtended with Food, which may frequently happen.

[7] Some of theſe Veins come from the *Cava*, thro' which the ceraceous Injection is tranſmitted, in the ſame manner as it was before thro' the Arteries; a manifeſt Indication that the moſt ſubtil and

and ſpirituous Part of the Aliment are abſorbed by them in the Stomach.

[8] The numerous Nerves of this Part ariſe from the *par Vagum*, in conjunction with the intercoſtal Nerves and the ſemilunar *Plexus*, ſome of whoſe Branches terminate in the muſcular Fibres of the Stomach; others are convoluted into various round or pyramidal *Papillæ*, which are diſperſed thro' the villous Coat, while other Branches are ſurpriſingly interwove in the nervous Coat of the Stomach, vaniſhing at laſt in that downy Subſtance, which, together with ſmall Veſſels, forms the villous Lining of the Stomach; whether the principal Office of this nervous Integument is to tranſfuſe the nervous Fluid into the Stomach by their ultimate and open Branches, we are not yet able to determine; but it will appear that all the Nerves terminate either in *Papillæ* for Senſation, in membranous Expanſions, or in muſcular Fibres, but never end in cloſe Cells. Theſe *Papillæ* have been demonſtrated by *Ruyſch* in ſeveral of his later Preparations, tho' they may be alſo proved to be in the Stomach by Experiment. The *Vinum benedictum*, which is made by letting red Wine ſtand a Night in an antimonial Glaſs, does not diſcover any uncommon *Stimulus* either to the Tongue or Noſe, and may be ſafely taken into the Stomach; but it is no ſooner arrived there, but it ſuddenly irritates the more ſenſible *Papillæ* of this Organ, and excites a Vomit; the Stomach is alſo ſenſible enough to accurately diſtinguiſh Poiſons, whence *Wepfer* well obſerves, there are ſeveral ſurpriſing Phænomena produced in this Organ by the *Hemlock* whilſt it remains in the Stomach, which immediately ceaſe upon its being diſcharged. It is alſo from this exquiſite Senſation of the Stomach, that

that ſome have imagined it to be the Seat of the Soul.

[9] This Liquor is conſpicuous when it regurgitates into the Mouth of hard Drinkers who are faſting, being not without an unpleaſant Guſt, which is popularly called Heart-water, being quite limpid, and very much like the Tears. When this Liquor is wanting, there ariſes a great Heat and Drought in the Stomach, curable by oily Emulſions; and what is ejected by vomiting this Liquor, forms a laſting Froth.

[10] That this *Succus gaſtricus* is extremely ſubtil, may be concluded from the Minutcneſs of its Veſſels, which tranſmit the ceraceous Part of the Injection without the Vermillion into the Stomach; and that it is poured into the Stomach in a conſiderable Quantity, is probable from the great Number and vaſt Extent of theſe Veſſels, together with the great impelling Force of the neighbouring *Aorta*, from whence they ariſe.

[11] A healthy Perſon who vomits with warm Water, and after Vomiting regurgitates this Liquor, finds no other Taſte in it than that of being a little ſaltiſh, like common Salt.

[12] The Chemiſts, and Followers of *Helmont*, have in general maintained, that there is an acid Liquor in the Stomach, which excites a Fermentation in the Aliment, impregnating the ſame with a vital Spirit, as well as diſſolving and digeſting it; but this Notion is repugnant to ſeveral moſt weighty Reaſons: For, 1. No Body could ever diſcover the *Succus gaſtricus* to be actually ſour. And, 2. All the Fluids of the human Body are not acrimonious, but replete with a neutral Salt, like *Sal Ammoniacum*; and if they incline more to one Claſs than another, they rather tend to the Alkaline; even *Helmont* himſelf acknowledges, that

there is not any Acid in the Veins, for if there was, he thinks it would cauſe a Pleuriſy; therefore if the Blood of the cœliac Artery contains a mild muriatic Salt, and conveys the ſame thro' its Branches diſperſed thro' the Stomach, there is no Reaſon or Experiment which will countenance a ſudden Change of an alcaleſcent Salt into an acid Ferment. The Argument which *Helmont* uſes, that he manifeſtly perceived the Breath of a Sparrow acid, demonſtrates nothing in reality, but that the Bread with which the Bird was fed turn'd ſowr in its Stomach; which it will do the ſooner, becauſe the intenſe Heat of that Part promotes the Degeneration of it to an Acid; hence Things which are moderately ſalted with Muriatics, or common Salt, may be very wholſome, ſuch as Herrings, *&c.*

[13] No Perſon could ever detect a perfectly alcaline Salt in any Part of the human Body; for if it were ſo, Life would ſoon be put to an end. There is no ſuch Salt in the Blood, nor even in the Bile, and much leſs ſhould we expect it in the aqueous Liquor in the Stomach; but Animal Food may putrify in the Stomach, in the ſame manner as it will in the open Air, and the ſooner, as the Heat of that Organ exceeds the Temper of the common Air.

[14] *Coſmus* III. grand Duke of *Tuſcany*, gave ſeveral voracious Animals out of the Reſervatory, where he kept uncommon Creatures, to be diſſected by his Academics, among which were Falcons, Eagles, Vultures, and Swans; upon opening the Stomachs of theſe after ſeveral Days faſting, there was no Relicks of the Aliment found in them, in the Preſence of *Malpighi*, *Borelli*, *Read*, *Finch*, and *Steno*, who expecting to find ſome ſharp and corroding Liquor, met with a very mild Juice, of a muriatic Taſte, notwithſtanding Eagles do not drink,

drink, and take ſo much Food at a time without any Maſtication, as will ſerve them for ſeveral Days, becauſe the Aliment conſtantly flows to their Stomach out of the *Gula*. They make it appear that this Liquor is not endued with any corroding Quality, nor does it ever conſume the Sides of the Stomach in thoſe Animals in which it is found; which would certainly be, if the Food was diſſolv'd by any Liquor approaching the Nature of *Aqua fortis*.

[15] The Monks, after a religious Faſt of twenty-four Hours, are troubled with a ſtinking Breath, and a gnawing Pain at their Stomach. Indeed all the Juices of the human Body do of themſelves become acrimonious without freſh Supplies; and this is the Caſe with Men after long faſting; whence malignant Fevers frequently ariſe for want of Proviſions in Cities that are beſieged. A Piece of Copper Money has indeed been found covered with Verdigreaſe in the Stomach of an Oſtrich; but that is no Argument for accuſing the Stomach with an Acid, for that Change may be made on Copper barely by the Moiſture of the Air with the mildeſt Salts.

[16] Theſe are truly ſimple Glands; for the ſmall Arteries ſpringing from the Cœliac, do in their ultimate Branches form what *Ruyſch* calls *Penicilli*, which are nothing more than oblong lenticular Cells, which receive this Juice inſtill'd by the ſmall Arteries, which are ſpent upon the Integument of each Cell, and by retaining the ſame, render its Conſiſtence thicker, till it is expreſſed thro' their patulent Mouths by the periſtaltic Motion of this Viſcus.

[17] The villous Coat being larger than the other Membranes of the Stomach, very pliable, ſoft, and inelaſtic, cauſes it to run into Wrinkles. This is

apparent from Experiment; for a human Stomach turned inſide out, and the *Gula* cloſed by a Ligature, upon diſtending it with Air forced thro' the *Pylorus*, the muſcular Coat will be expanded, and the *Rugæ* of the villous Coat, which is now outermoſt, will be then diſſipated; but upon diſcharging the Air, the moſt elaſtic of the Membranes will contract and wrinkle thoſe which are leſs ſo; but there will always be ſome Part of the Aliment detained between the *Plicæ* of the Stomach, which cannot be entirely diſcharged by the ſtrongeſt Contraction of that Organ.

18 Theſe quadrangular or quinquangular Cells are moſt conſpicuous in the Stomach of ruminating Animals, where the rough Pleats of the Stomach, in conjunction with theſe, ſerve to retain the Aliment from too quick a Paſſage. In the ſame manner alſo the half digeſted Aliment is retained by the *Rugæ* in the human Stomach, which is the reaſon why that Organ is hardly ever entirely emptied, but retaining ſome ſmall Part between the Folds, which becomes acrimonious by its long Stay, ſtimulates the Stomach by its Acrimony, ſo as to excite Hunger or increaſe the Appetite.

19 The Aliment which is retained, and ſtagnates between the Folds of the Stomach, is fermented by its long Stay, and changed from its natural Diſpoſition to an acrimonious one, either tending to an Acid or an Alkali.

20 If the internal Surface of the Stomach was ſmooth, it would then indeed compreſs, but not grind the Aliment which it receives: but the *Rugæ* or Pleats of the Stomach are ſoft, flaccid, and looſe in its Cavity; ſo that being agitated by the muſcular Coat, they grind and rub againſt each other, and divide ſuch Parts of the Aliment as are intercepted betwixt them; but if there is no Ali-

ment to interpoſe between the *Rugæ*, they will be injur'd by rubbing againſt each other, and give an uneaſy Senſation to the nervous *Papillæ*, which we call Hunger.

[21] The very large Claſs of graniverous Fowls are deſtitute of Teeth, and live only upon vegeble Seeds, the Meal of which only is nouriſhing, tho' they are inveſted with two hard Coats. To ſupply the place of Teeth, they have therefore a particular Mechaniſm in their Stomachs; in the fore Part of the Neck, above the *Sternum*, the *Oeſophagus* is dilated into a membranous Bag, the Crop, repleniſhed with ſmall ſalival Glands, which diſcharge a Liquor to mollify the Grain; in this Stomach the entire Seeds are macerated till they become ſoft and friable; they are then protruded into the *Abdomen*, below the *Diaphragm*, where they are ground together by two Pair of ſtrong Muſcles, in the room of a Stomach, which receive the Grain thro' a narrow oval Slit, and are lined within-ſide by a callous Membrane, which being rough and wrinkled, performs the Office of Teeth upon the mollified Aliment. Theſe Animals have therefore diſtinct Organs apart for the Performance of what is effected in the human Body by one Machine; for in us the Aliment is both macerated with the ſalival Liquor, and ground with the Action of the Muſcles in one and the ſame Stomach; whereas Fowls mollify their Aliment in one Stomach, and grind it in another; but as the Seeds which they feed upon cannot be ground aſunder even when mollified, without a conſiderable muſcular Force, too violent to be ſuffer'd without Injury, by the villous Coat which affords the mollifying Liquor, it was therefore neceſſary that the two Offices ſhould be performed aſunder. Thus we find Beans and Tares ſoft, friable, and ſplit or

burſt in the Crops of Pigeons, but in the Stomach we find them attenuated into a pulpy Subſtance.

§. 78. If it be conſider'd that a large Quantity of *Saliva* [1] continually flows out of the Mouth and *Oeſophagus* to the Food now arrived in the Stomach, together with the *Succus gaſtricus* of the Stomach itſelf, which is conſtantly diſcharged from its villous Coat; the Aliment muſt neceſſarily be well diluted thereby; and being mix'd with the Relicks of the laſt Meal as a Ferment, and excited to an inteſtine Motion by the included Particles of *Air* [2], expanded by the *Heat* [3] of the adjacent *Viſcera* and Veſſels; the Conſequences hereof muſt apparently be a *Maceration* [4], Dilution, Rarifaction, and *Fermentation* [5], or incipient Putrifaction of the Aliment, whereby it is either intimately and uniformly diſſolved into a good Chyle, fit to *ſupply* [6] the Abraſion of the Solid, and Conſumption of the fluid Parts of the Body, or elſe into a rancid and offenſive Maſs. —— The external or convex Side of the villous or internal Coat of the Stomach is compoſed of all the ſame Veſſels before-mentioned (§. 77.) which it receives from the next vaſcular and nervous Coat that inveſts it; which being nothing but an Intertexture or Network of ſmall Arteries, Veins and Nerves, detaches many of the ſmalleſt thro' the villous Integument, which ſupply the *Succus gaſtricus* and *Mucus* before-mentioned, partly by ſtrait Ducts or Tubes, and partly from Pores and Cells.

[1] The

[1] The *Saliva*, tho' not a Liquor proper to the Stomach, is a principal and neceſſary Ingredient in digeſting the Aliment. The Quantity of *Saliva* ſeparated and diſcharged into the Stomach in a Day, is eſtimated to be about twelve Ounces, which is entirely ſwallowed by People in health. I have obſerved in myſelf the *Saliva* to be ſeparated in different Quantities at different Times of the Year, ſometimes not above a Drachm in an Hour, ſometimes half an Ounce, and at other times near two Ounces, tho' the *Saliva* was not ſollicited in its Diſcharge by talking or ſpitting. Hence it happens that brown Bread, which has been ſwallow'd whole without chewing, may be vomited up again a few Hours after with little or no Alteration; but if the ſame was intimately divided by the Teeth, and mixed with the *Saliva*, it will be formed into a white Liquor, like Chyle; but the *Saliva* will appear to be ſeparated in much larger Quantities, if we add that which is mixed with the Food, and paſſes into the Stomach, to that which may be ſpit out in a certain Time; but if we compare the Size of the Stomach with that of the ſalival Glands, the very large Surface of the villous Coat, with the great Number and Diameters of the Arteries, it will be apparent that the Proportion of the *Succus gaſtricus* is much larger than that of the *Saliva*; whence it happens that Girls ſometimes digeſt hard Cruſts of Bread, and other dry Subſtances, without any Drink, the *Succus gaſtricus* ſupplying all the Liquor which is neceſſary to macerate and diſſolve the ſame.

[2] A very conſiderable Quantity of Air deſcends into the Stomach included in ſmall ſalival and mucous Veſicles, the Air having a free Paſſage into the Mouth at every Inſpiration between the Acts of Deglutition; ſo that it not only deſcends into

the *Trachea*, but alſo into the *Oeſophagus*; but the Efficacy of the Air to diſſolve the Aliment (mentioned §. 69. N. 1.) is much greater in a cloſe and warm Place than in the Mouth.

[3] The great Power of Heat in diſſolving many even of the hardeſt Bodies, and all thoſe which we eat, is demonſtrated by the digeſting Machine of *Papin*. Eggs alſo are converted into a putrid Maſs by 92 or 93 Degrees of Heat, inſomuch that the volatiliz'd Humours exhale even thro' the Shell; but this Heat is the ſame with that of our Stomach.

[4] Tenacious Subſtances ground with Water are ſlowly, in Proceſs of Time, mollified by the Water inſinuating itſelf into the Pores of the macerated Body; but Maceration is effected in Perfection in the Stomach, where there is a large Quantity of diluting Liquor, with a conſtant and gentle Attrition, by which means the hard Sea Biſket-Bread becomes mollified in the Stomach, and affords good Chyle.

[5] This is proved, in oppoſition to ſome of the more ſevere Mechaniſions; it is alſo apparent by the vinous or acetous Odour which frequently aſcends in Belchings, thro' the *Fauces* of Men or ruminating Cattle; to which we may alſo add the Tumefaction of the Stomach, which frequently follows an Hour or two after a Meal, which ariſes from the Air expanded by Heat; for the Air admitted and included in the Pores of Bodies, and excited by Heat, ſeems to be the general Cauſe of Rarefaction in them; nor is it poſſible for our aſceſcent Food to be converted into the volatile and alcaleſcent Nature of our Fluids, if they did not ſuffer a Change in their ſmaller Particles. Hence the adept Chemiſts have ſtiled Fermentation one of the operating Hands of Nature, for it is that

Operation

Operation only which produces an inflammable Spirit from Vegetables; but this Fermentation in the Stomach is ſtopt in its beginning by the large Quantity of freſh ſecerned Liquor which is continually poured into it, and eſpecially by the Acceſſion of the Bile, an utter Enemy to all Fermentation,

' From what has been now declared §. 78. it appears that the Efficacy of the *Saliva* and *Succus gaſtricus*, or Juice of the Stomach, is very conſiderable in changing the Nature of our Aliment to that of animal Subſtance, for which it ſeems to be principally deſigned; for it is very certain, that there is a larger Quantity of thoſe Liquors poured into the Stomach than will equal the Aliment itſelf which we take; which is alſo apparent from the Conſiſtence of the Chyle, reſembling new Cream; it is therefore in the Stomach principally that the Aliment begins to put on the Nature of animal Subſtance.

§. 79. But this is not ſufficient to explain how the more ſolid Food is intimately digeſted or diſſolved in the Stomach with little or no previous Maſtication.

' The ſolid animal and vegetable Food which is ſwallowed with little or no Maſtication by labouring, hungry, and rapacious Men, conſiſts of ſuch hard Parts and tough Fibres, that it is inconceivable how the *Saliva* and Liquor of the Stomach alone ſhould make that Change in them which we find in Digeſtion; for we find that Food, however groſs, is at laſt diſſolv'd and attenuated into Chyle; and if they are of a ſtrong Conſtitution, they perfectly digeſt the ſame into laudable Juices; there muſt therefore be other Cauſes than the preceding

to

to account for ſo remarkable a Change of the Aliment into Chyle in the human Stomach.

§. 80. But to diveſtigate the Cauſe of this Change of the Aliment in Digeſtion, we ought to conſider the *muſcular Structure* [1] of the Stomach, and explain the Action that Organ exerts by ſuch Structure,

[1] We call that Part of the human Body muſcular which conſiſts of contractile Fibres, inveſted with a Power of approximating their Extremities to each other, and of drawing the moveable Part, into which they are inſerted, towards the leſs movable, which is their proper Action, whether thoſe Fibres are ſoft and lax, or tendonous; whether they run longitudinally, according to the Direction of the Bone in which they are inſerted, or whether they inveſt ſome circular Cavity; whether they are pale, without Blood, or ſtain'd red with the *Cruor*; for neither their circular Direction nor pale Colour diminiſh their Power, as appears from the Action of the Stomach, Inteſtines, and Arteries.

§. 81. The muſcular Coat of the Stomach *appears* [1] to conſiſt of very ſtrong muſcular Fibres, chiefly in its external or convex Part, which beginning at the upper Orifice, paſs in a circular or *ſpiral* [2] Direction to the *Pylorus*. Theſe Fibres inveſt the Cavity of the Stomach in a Direction almoſt perpendicular to its Length, by which means they contract the Sides of the Stomach, and make it narrower; being alſo cover'd with the cellular Subſtance of *Ruyſch*, which ſupplies the Oil neceſſary to lubricate

lubricate and ſoften the muſcular Fibres in Action; but the internal or concave Surface of the ſame Coat is compoſed in its lower Part of oblique Fibres, contracting the bottom of the Stomach obliquely towards the back Part of it, and towards its upper Orifice, whereby they ſhorten the Length of the Stomach; whereas the ſecond Order of Fibres, in the upper Part, are of a greater Strength, and paſs in a parallel Direction, according to the Length of the Stomach from its upper Orifice to the *Pylorus*, behind which they unite and inveſt its whole Length, as they alſo inveſt the upper Orifice; ſo that when the Stomach is empty, they draw its Orifices nearer *together* [3]; but when the Stomach, being full of Aliment, keeps them diſtended, ſo that they cannot approximate its Orifices, they then gently cloſe its upper Orifice, and very ſtrongly contract the *Pylorus*.

[1] When the Stomach of a healthy Man, ſoon after dying a violent Death, is gently diſtended with Wind to about the Size it uſually is with Food, we may then with a gentle Hand take off carefully its external Coat.

[2] Theſe Fibres ariſe from the upper Orifice, and deſcend to its lower, encompaſſing the Stomach in a ſpiral Direction, they contract its Capacity, and compreſs the included Aliment; tho' they do not act altogether, but ſucceſſively, beginning from the *Oeſophagus*, as *Wepfer* has obſerv'd in the Stomachs of living Dogs, who do not ruminate, but have that Organ the ſame as the human Stomach.

[3] Theſe Fibres are twenty times ſtronger than the preceding, but they form a *Stratum* of not above

above four Fingers Breadth. In the Stomach of a dead Subject they appear ſeparated, relaxed, and as if they were divided from each other; but their State is not ſuch in Life. The large and thin Bladder of Urine is ſometimes contracted in the human Subject to the Size of a Walnut, and the Stomach is frequently no larger than one's Fiſt. They run from the left Orifice of the Stomach to the right, and encompaſs both with their ſtrong muſcular Fibres; they act all together, contract the Length of the Stomach, diminiſh its Capacity, and bring its two Mouths to each other. All theſe Fibres do not begin to act till the Stomach is moderately full, till then they are at reſt; but the more the Stomach is diſtended, the more forcibly they are contracted; inſomuch that when it is over-fill'd, it cannot empty itſelf, but remains diſtended with exquiſite Pain, till it occaſions Death, or a Palſy of the now mentioned Fibres, whoſe principal Service to the Stomach, is to retain the Aliment from paſſing out too ſoon; and when they have loſt their Tone and Action, the Food then quickly paſſes thro' the Stomach with little or no Change from its Action, cauſing a Lientery.

§. 82. This muſcular Coat alſo appears not only to be covered with the *cellular*[1] Membrane of *Ruyſch* (§. 81.) but alſo with another externally, which in the convex Part is very full of Veſſels, and in the concave Part furniſhed with longitudinal and parallel Fibres, ſerving to contract or ſhorten the Length of the Stomach.

[1] This cellular Coat inveſts the whole Body, and every Muſcle and Part which moves and rubs againſt others, or contains any thing acrimonious; it

it is compoſed of an infinite Number of Follicles, or little Bladders, which receive and retain the oily Part of the Blood from the ultimate Branches of the ſmall Arteries, and have ſuch a Communication with each other throughout the whole Body, that by gradually applying Bandages to the ſwell'd Feet and Legs of dropſical Patients, the Humour will be drove up to the Head, and inſomuch that a Man whoſe whole Body was ſwell'd with an *Anaſarca*, upon burning his Foot as he ſlept by the Fire-ſide in the Winter, was cured by the Waters running entirely out, as if it had been from a Caſk; and Wind blown into this Membrane in any Part of the Body, may be drove thro' it in all the reſt, by which means Butchers endeavour to impoſe lean for fat Meat upon the Buyer by inflating it. Part of this Membrane is called *Adipoſa*, being one of the common Integuments of the Body, next to the Skin; but there is another much thinner Part of it, which inveſts the ſmaller Muſcles and their Membranes, diſtinguiſh'd with the Name of *cellular Coats* by their Inventor *Ruyſch*. This Membrane has many Uſes in the human Body; it lubricates the muſcular Fibres with its Oil, prevents the Muſcles adhering to their Integuments, abates the Attrition of Parts, *&c.* inſomuch that when this Membrane is deſtroyed by a Gangrene, it is attended with an Immobility of the Muſcles; but when theſe Cells are diſtended with too large a Quantity of Oil, it produces an oppoſite Diſeaſe, and renders the Muſcles unfit for motion, by clogging them; of which fat People are too well aſſured by Experience.

§. 83. Tho' the forementioned muſcular Fibres are very contractile, yet they are *incapable*

ble[1] of entirely emptying the Stomach; when they act together they close the two Apertures, where the *Oesophagus* and *Duodenum* are inserted some way into the Stomach, which are also naturally contracted of themselves by their own Structure; they strongly compress the distending Contents of the Stomach, mix and grind them together by their peristaltic Motion, and Impulse from the Motion of the adjacent Parts; they keep back the more gross Parts of the Food in the Stomach, and further attenuate the same, expelling the more fluid Parts into the Cavity before the *Pylorus*, and even thro' the *Pylorus* itself into the *Duodenum*, notwithstanding the Resistance arising from the perpendicular Ascent of the *Pylorus*, its Incurvation, muscular Contraction, greater internal Thickness, and the valvular Insertion of the *Duodenum* into it; and thus the Aliment, reduced to an Ash-colour'd thick Fluid in the Stomach, is pressed slowly, and by little at a time, rather thro' the *Pylorus* into the *Duodenum*, than by the upper Orifice into the *Oesophagus*; because the latter lies much higher, and is more firmly closed by the *Diaphragm*.

[1] The Contraction of every Muscle is limited to a certain degree, which it cannot exceed. In the Stomach this Contraction is limited to about four or five Ounces of Liquor, which the Stomach cannot expel out of its Cavity; and in the dead Subject, where the Stomach is collapsed, it will admit of five Ounces, without appearing to be distended; the circular Fibres are no where disposed so as to contract

contract the Capacity of the Stomach, that it will not receive a Quantity of Aliment without Diſtenſion, which *Bernouli* has demonſtrated in a Theorem; it therefore appears that the Stomach begins to compreſs the Aliment when it contains more than five Ounces, which it cannot do when there is leſs, becauſe there is a Space left capable of receiving five Ounces of Water; like as a Cord does not begin to contract itſelf, but when it is drawn out beyond its natural Length; but when it is returned to its former Length, it then ceaſes to contract any more; therefore the Stomach is never entirely emptied, nor its Sides brought cloſe to each other; but if it is contracted beyond the above mentioned Capacity, it muſt be owing rather to the Preſſure of the *Diaphragm* and Muſcles of the *Abdomen*, than the Contraction of its muſcular Coat. If the Stomach be filled with Wind, and held to the Fire to give it a greater Expanſion, upon wounding the ſame, the Air will be expell'd by the Contraction of the Stomach, but the whole Quantity of Air will not be diſcharged, ſo as to leave the Stomach quite empty; the ſame may alſo be better performed if the Stomach is diſtended with Water inſtead of Air, which will be forced out thro' the Puncture, till the Stomach is contracted to its natural Capacity: hence it appears that the Action of the Stomach is not wholly to be referr'd to Trituration, as ſome great Men have been too eaſily perſuaded. The Stomach of a Dog or a Hog has the ſame Structure with that of the human Body; therefore theſe Animals have been choſe for Experiments, by giving Vomits, by which accurate Obſervation has been made of the manner wherein the Stomach is contracted by the periſtaltic Motion being increaſed, being ſometimes elongated, and at other times ſhortened, by its two

Orifices

Orifices approaching each other, but yet never ſo much contracted as to be entirely emptied; therefore a Quantity of Aliment which is leſs than five Ounces, ought by this Experiment to be incapable of the digeſtive Power of the Stomach. But this is contrary to Experience, which aſſures us, that many things the moſt agreeable to the Palate, may be well digeſted in much leſs Quantities; for if a weak Perſon ſhould take an Ounce of Food every Hour, the ſame would be very well digeſted, notwithſtanding it ſuffered no Preſſure or Trituration from the muſcular Structure of that Organ. However, the Action of the Stomach in this reſpect ſeems to be weak when it contains very little Aliment, and ſtrongeſt when it is half full; but when it is too much diſtended, the Aliment ſuffers hardly any Action at all from the Stomach; ſo that after a moderate Meal the Appetite will quickly return again at its uſual times; but by immoderate eating the Appetite will be palled for ſeveral Days, by the Putrifaction of the Aliment, occaſioned by its too long Stay in the Stomach.

§. 84. Some Creatures have ſcarce any other Power than this contractile Force of the Stomach to digeſt or grind their macerated Aliment, but to a much *ſtronger degree* [1] than what is exerted in the human Stomach; and in ſome of them this Motion may even be heard, as well as proved, by an Obſervation of its Effects; and the nervous and muſcular Structure of this Organ in the human Body, compared with the like Structure of the ſame Organ in Brutes, demonſtrates *the ſame* [2] in us.

[1] The

[1] The Oſtrich, and other graniverous Fowls, have been obſerved to grind Glaſs in their Stomachs with ſuch a Force, as to occaſion a grating perceptible by the Ear, and to break off the angular Parts of the Glaſs without any Prejudice to the Bird; for the Oſtrich has no Crop or preparatory Stomach; but its true Stomach is armed with very ſtrong Muſcles, and it ſwallows Pieces of Iron and Stones, that by the Attrition of thoſe hard Bodies, together with the Aliment, the latter may be more expeditiouſly attenuated or divided; but that it feeds upon Iron, is a falſe Report.

[2] Several eminent Men have imagin'd, that there was the ſame Attrition in the human Stomach as they had before obſerved in Birds; but they ought to have conſider'd, that the Structure of that Organ in the human Body is very different, and therefore cannot be expected to perform the ſame Action; the muſcular Fibres in the human Stomach are very few and weak, and its villous Coat very thin; whereas that of Birds is fleſhy, and compoſed of very ſtrong Muſcles, and its rough Lining that grinds their Food is tough and cartilaginous.

§. 85. From hence we may underſtand the reaſon, why when but little Aliment is taken, it is *quickly diſcharged* [1] out of the Stomach; and why when the Stomach is over-fill'd, it neither digeſts nor diſcharges its Contents as uſual, but after retaining the ſame ſome time, it is vomited up *crude* [2]; and why when *Liquors* [3] are ſuddenly drank in large Quantities, they ſtay a long time in the Stomach.

[1] Becauſe the Rank of parallel Fibres, which are detach'd from one Orifice of the Stomach to the

ther, are then flaccid; yet thoſe Fibres will again act, when the Stomach is diſtended beyond the Capacity of five Ounces of Liquor; but even after that, the Aliment is eaſily preſſed out of the Stomach, not by its own muſcular Contraction, which then ceaſes, but by the Preſſure of the adjacent Muſcles and incumbent *Diaphragm*; which laſt deſcending at every Inſpiration, forces out the Contents of the Stomach.

2 A young Glutton comes home from feaſting with his Stomach cramm'd full of Varieties, which being retained therein for about 8 or 10 Hours, will cauſe a great Diſtenſion of the ſame, not only by its large Quantity, but alſo much more by Fermentation and Rarefaction; but no Part of it eſcapes out of the Stomach, whoſe Orifices are then contracted, and its circular Fibres render'd paralytic; till at length, cauſing great Reaching and Uneaſineſs, the Fibres between the Orifices of the Stomach being relaxed, and its Mouths opened, the Aliment, which was before retained with ſo much Uneaſineſs, is expelled both upward and downward, but more above than below, becauſe all the Fibres of the upper Orifice being relaxed, the *Flatus* generated by the Food, is uſually found to diſcharge itſelf that way. Thus the Conſul *Antonius* vomiting up his *Crapula* of the Day before, daubed his Alderman's Gown, and filled the whole Seſſion-houſe with the ſtinking Smell of the Wine and his gorged Varieties. But the longitudinal Fibres of the Stomach uſually hold contracted much longer, as they lie cloſer together, and exert a greater Force; the Orifices of the Stomach are eſpecially contracted ſtrongly; for the *Oeſophagus* paſſing through the *Diaphragm*, is in that Part furniſhed with ſtrong muſcular Fibres, whereby it is conſtringed; but the muſcular Part of the *Duo-*

denum

denum is not continuous with the muſcular Coat of the Stomach, but inſerts its muſcular Tube a little way within that of the Stomach, ſo that it may be cloſed by a Contraction of the Fibres of the Stomach; whence it happens in unactive People, that the tranſverſe Fibres being relaxed, the longitudinal Fibres interpoſed between the two Orifices of the Stomach, perſiſt in their Contraction, and retain the Aliment in the Stomach with a conſiderable Force, till having arrived to its greateſt Diſtenſion, and the Nerves and Arteries being by that means compreſſed, thoſe Fibres which are ſupplied by them, muſt neceſſarily ceaſe to act; but the Aliment thus retained will remain crude or indigeſted, becauſe the Mouth of the *Oeſophagus* being cloſed, will not admit the *Saliva*; alſo the Stomach itſelf being greatly diſtended, and its Veſſels by that means compreſſed, will not ſeparate the *Succus gaſtricus* as uſual, nor ſuffer its wonted Attrition; it therefore follows, that the Aliment thus left to itſelf, will be fermented and variouſly changed, according to its different nature, into a putrid Maſs; whence it happens, that what is vomited by drunken People, is uſually very acrimonious; and Wine itſelf, which is of an aceſſent Nature, is quickly converted into a moſt ſharp Vinegar.

[3] Great Drinkers, if they indulge themſelves with large Draughts at very ſmall Intervals, are ſoon made ſick and drunk thereby; but if they ſtay ſome time between each, and do not drink more Liquor till the preceding has been heated by the Stomach, they will then bear much more Wine without Injury; and if they vomit, it will be more eaſily; becauſe the Coldneſs of the Liquors contracts the Stomach, ſo as to make it expel what was in it before, and retain what came into it laſt;

therefore they who drink large Quantities of cold mineral Waters at a time, are frequently troubled with Pains at their Stomach, from the Waters not finding a Paſſage either by Urine or Stool; and even Polypuſſes have been ſeen formed in the Arteries of the Stomach, from a too plentiful and ſudden drinking of cold Liquors; in which Caſe the moſt ſpeedy Remedy is to excite a Vomit, by tickling the *Fauces* and *Pharynx* with an oiled Feather; whereas if they were to drink their Waters by ſmall and repeated Draughts, they would not only purge well, but run thro' the Body as thro' an open Tube, and eaſily produce their deſired Effects.

§. 86. The Cauſes already explained may indeed ſeem *inſufficient* [1] thus to digeſt and change the Food in the Stomach; but this Difficulty will be removed, if we conſider, 1. The conſtant attenuating *Heat* [2] of the circumjacent Parts, the Heart, Liver, Spleen, Aorta, Meſentery, Arteries and Veins, by which the Stomach is expoſed on every ſide to the ſtrongeſt Heat in the whole Body. 2. The innumerable *Vibrations* [3] of the Arteries near the Heart, and which are ſpent upon the Stomach, *Diaphragm*, *Omentum*, Meſentery, Spleen, Liver, *Pancreas*, and the *Peritonæum*. 3. The violent Pulſations or Strokes of the ſubjacent *Aorta* [4]. 4. The great Force of the *nervous* [5] and glandular Juices, ſcarce more plentiful in any Part. 5. The continual reciprocal and ſtrong Compreſſion from almoſt the whole *Peritonæum* agitating and preſſing upon the Stomach, (1.) by means of the *Diaphragm*,

phragm, which is a large Muſcle ariſing on the lower part of the Right-ſide from the three firſt *Vertebræ* of the Loins, and on the Left Side tendonous, from the laſt and laſt but one of the *Vertebræ* of the *Thorax* tendonous, above which it ariſes fleſhy, with its Fibres paſſing directly upward, and expanding again tendonous; ſo that on the upper part it ariſes thin and membranous, and afterwards fleſhy, from the whole Margin of the cartilaginous Ends of the lower Ribs, and lower Part of the *Sternum*, detaching its Fibres towards the Center, where they become tendonous with the preceding; ſo that this Muſcle acting from a convex Poſition in the *Thorax*, to a plain one in the *Abdomen*, compreſſes all *the Viſcera* [6] of the latter, and particularly the Stomach. (2.) By the *ten Muſcles of the Abdomen* [7] ſtrongly compreſſing all the Contents of that Cavity, by their united and reciprocal Contractions, and exerting a conſiderable Force upon the Stomach, as we are informed by Experience and Obſervation; for, 1. the external oblique Muſcles ariſing tendonous and fleſhy from the lower Margin of the twelve lower Ribs, and aſcending obliquely forward, are inſerted by a tendonous Expanſion into the whole *Linea alba*, over the right internal oblique and tranſverſe Muſcles, alſo into the anterior and upper Edge of the *Os Pubis* and *Ilium*. 2. The oblique internal Muſcles, which ariſe fleſhy from the circular Margin of the *Os Ilium* and Ligament of the *Os Pubis*, conſiſting of Fibres

aſcending obliquely forward, horizontally, and downward, and becoming tendonous, are inſerted into the *Linea alba*, and the Cartilages of the five lower Ribs. 3. The pyramidal Muſcles, which ariſe fleſhy from the upper and anterior Part of the *Os Pubis*, and are inſerted tendonous into the *Linea alba* and Navel. 4. The tranſverſe Muſcles of the *Abdomen*, ariſing fleſhy from a tendonous Expanſion, fixed between the tranſverſe Proceſſes of the *Vertebræ* of the Loins, Spine of the *Os Ilium*, Ligament of the *Os Pubis*, and the cartilaginous Ends of the Ribs below the *Sternum*, and are inſerted by a broad Tendon into the whole *Linea alba*, under the right Muſcles of the *Abdomen*. 5. And laſtly, the *Recti*-Muſcles, which ariſing fleſhy from the enſiform Cartilage, and the Cartilages of the two lower true, and two upper baſtard Ribs, are afterwards divided into five muſcular Portions by as many tendonous Innervations, being at laſt inſerted into the upper and fore Part of the *Os Pubis*.

[1] Becauſe a ſmall Quantity of Food is quickly and perfectly digeſted, and paſſes out of the Stomach into the Inteſtines without the Aſſiſtance of the muſcular Fibres.

[2] *Galen* compares the Stomach to a Pot, under which is placed the Fire of the Liver; and indeed if there is no Fire under it, there is a very great Heat conſtantly adminiſter'd to it by the adjacent Parts; for the Stomach is encompaſſed above by the Heart, ſeparated from it only by the inconſiderable Thickneſs of the *Diaphragm*; the *Omentum*, and Meſentery, keep it warm below; behind it the

Aorta diſtributes its large Stream of warm Blood; the thin and warm Exhalation of the *Abdomen* communicates to it the gentle Heat of a vaporous Bath, and then no Heat reſolves Subſtances more powerfully than that of the human Body; too ſtrong a Heat often compacts Things together, but the Heat of the Atmoſphere, which is leſs than that of the human Body, reſolves Fleſh itſelf into a liquid Maſs within the Space of three Days. And under the Equator, where the Sun is directed perpendicularly to the Earth, Muſt is converted into Wine by a Fermentation within the Space of twenty-four Hours. The Baker's Dough is render'd agreeable to the Palate by no other Artifice, than by fermenting it ſome time at the Mouth of the Oven before baking. Eggs, which are turned hard in a ſtrong Heat, are in a ſhort time converted into a very thin Fluid by the Heat of the human Body; whence it appears that the Effect of Heat in digeſting the Aliment is very conſiderable, tho' Digeſtion is not wholly performed thereby, as was imagined by the Ancients.

[3] The Vibrations of the Arteries, which are diſtributed ſo plentifully, and ſufficiently large about the Stomach, being agitated alternately by Dilatation in their *Diaſtole*, and Contraction of their *Syſtole*; when they are contracted, they preſs againſt the Sides of the Stomach, and ſhake the contiguous Aliment. This Vibration of the Arteries is communicated to every Part of the Stomach, encompaſſed by the other *Viſcera*, which are full of the like Veſſels. The Vibrations of theſe numberleſs Arteries are communicated to the Stomach three thouſand and ſix hundred times in an Hour, for ſo often are they dilated and contracted in that Time. But we find the alternate and repeated Action of Water will make Excavations in Stone; and in

like manner the Vibrations of the innumerable ſmall Arteries may perform the ſame Effect, as if contracted into one ſtronger and ſhorter Impulſe. A Drop of Water falling from an Height upon a Marble, will by being repeated 1000 times, ſtrike off a Piece of the Stone equal to what a like Body a thouſand times greater would ſtrike off by one Fall from the ſame Height. In the ſame manner the Vibration of the ſmall Arteries repeated three thouſand times, will exert the ſame Force upon the Stomach, as would have been exerted by a greater Impulſe in a ſhorter time, eſpecially as we find that ſo ſmall Arteries as thoſe of the *Dura Mater*, make their ſtrong Impreſſions upon the hard Bones of the *Cranium*; in Proportion to which, the Arteries of the Stomach, which are ſo much larger, muſt exert a very great Power upon the Sides of the Stomach, which is ſo much ſofter. Nor ought it to be objected, that the Arteries make their Impreſſions upon the Bones of the *Cranium* in the tender infantine State, for the Arteries were then ſofter than the *Cranium*, and their Impreſſions grow ſtronger as the Animal becomes more adult; but the weaker any Perſon is, the more frequent is his Pulſe, inſomuch that the Artery ſometimes beats ſix thouſand times in an Hour; and ſo the Vibration of the Arteries upon the Stomach is ſtronger in Health, but more frequent in Diſeaſes; nor do I think their Action can ever be ſo weak, as not to equal the Contraction of its muſcular Coat.

[4] The *Aorta*, which conveys the ardent and vital Stream, reſiſted behind by the *Vertebræ* of the Back, violently agitates the Stomach, which lies before it; and if the Muſcles of the *Abdomen* preſs the Stomach backward, as they generally do, it is in a manner ſqueez'd between two ſtrong Preſſes; but

but the great Force of the *Aorta* may be judg'd of from its having a Power more than equal to the Reſiſtance of all the other Arteries put together; and even the Artery in the Ham, which is none of the largeſt, will elevate not only the whole Leg, but alſo an additional Weight; we may alſo judge of it by the Force with which one's Finger is compreſſed when inſerted into the *Aorta* of a living Dog.

5 Concerning the Nature of the nervous Juice, and Termination of the Nerves, we ſhall ſpeak more largely hereafter; where it will appear, that none of them are cloſed, but pervaded by the nervous Juice, which is extremely ſubtil and moveable, ſo as to exceed the diſſolving Power of any other Fluid in the Body; but if one may gueſs at the Action of this Fluid in the Stomach by its Nature and Affuſion, by the vaſt Number of its Nerves, it will appear to be very conſiderable, becauſe the nervous *Papillæ* of the Stomach are very plentifully ſupplied with their Branches; therefore the diſſolving Power of this Juice in the Stomach is very great.

6 The Stomach is ſituated in the *Abdomen*, which is a kind of a Machine, fixed behind, but moveable in its upper and anterior Part, ſo that by the *Diaphragm*, abdominal Muſcles and *Aorta*, the Stomach is perpetually agitated upward and downward, backward and forward, the more ſtrongly as it is more full. The Cavity of the *Abdomen* has not any Part empty, nor is the Stomach ſuſpended among its *Viſcera* as in a Fluid; but being mov'd in a Place that is already full, it preſſes againſt the adjacent Parts, and that Preſſure is alſo returned again upon the Stomach; it deſcends with the *Diaphragm*, and is again preſſed upwards with that Muſcle, by which means the Food ſuffers a Diviſion, like that of boiled Peas in a Bladder,

der, compreſſed alternately with a conſiderable Force by the Hands of a Man. The *Diaphragm* in Expiration aſcends to the Line at the bottom of each Breaſt, which is obſerved by few, nor is it drawn in that Poſition in anatomical Figures; but when it is flattened towards the *Abdomen*, it preſſes the Stomach downward and forward; and as the Muſcles of the *Abdomen* re-act in Expiration, it will be again by them preſſed upward and backward; thus by the continued Action of theſe two Powers, the *Diaphragm* and Muſcles of the *Abdomen*, the Viſcera contained in that Cavity are perpetually agitated upward and downward; the Conſequence of which will be, an Attrition in the Stomach, and a Diviſion of the Aliment into minute Parts; and this Force is the ſtronger upon the Stomach, as it reſiſts by a greater Diſtenſion; but the Force of the *Diaphragm* in this reſpect may be judged of by Inſpection, as when the abdominal Muſcles of a living Dog are divided, and the Viſcera of the *Abdomen* are forcibly preſſed down by it, and endeavour to come out of the Wound; but when the *Peritonæum* itſelf is divided, the Inteſtines are then protruded with a conſiderable Murmuring and *Impetus*; and if the Finger is inſerted at the Wound, it will be preſſed with a conſiderable Force; all which Preſſure is owing to the *Diaphragm*, by whoſe Action in vomiting the Contents of the Stomach are expelled with great Violence upwards; but downward, if it is to be diſcharged *per Anum*.

[7] The Muſcles of the *Abdomen* are ſo diſpoſed, that there is always ſome fleſhy Part of them ſubjected under the tendonous, by which means the whole Capacity of the *Abdomen* is equally contracted; the fleſhy Part of the oblique deſcending Muſcle lies almoſt entirely above, but becomes tendon-

ous

ous below; but then the oblique aſcending Muſcle ariſes fleſhy below, and tendinous above, and ſo fills up the Inequality which would have been occaſioned by the preceding Muſcle alone; but then in the middle of theſe Muſcles backward there is a Deficiency, which is again ſupplied by the fleſhy Belly of the tranſverſe; but then all theſe are converted into a thin Tendon in their anterior Part, which is therefore ſupplied, ſo as to be equal, by the fleſhy Recti-muſcles; which if inſerted broad at the bottom, have no Addition, as *Riolan* obſerves; but if they are inſerted narrow, they are uſually ſupplied with the pyramidal Muſcles.

§. 87. If we therefore conſider the united Force of theſe ſeveral concurring Cauſes (§. 76, to 87.) acting together upon the mix'd Aliment (§. 49, to 57.) which is then become ſufficiently *ſoft* [1] and ſoluble, being compoſed of vegetable and animal Juices, cloſely confined and mixed together by gentle Cauſes, and of their own Nature apt to ferment, putrify, and turn rancid in a warm and cloſe [2] Place, we may evidently perceive that the Alterations the Aliment undergoes in the Stomach muſt be ſuch as follow.

(1.) That the finer Part of the Aliment is mixed, ground or diſſolved [3], and attenuated by the Juices in the Stomach, puts on the Form of a [4] grey-coloured Pulp, which paſſes out of the Stomach, where there is the leaſt Reſiſtance [5].

(2.) That the groſſer and more tough [6] Parts of the Aliment are retained in the Stomach, after the more fluid have been diſcharged; and by continuing to ſuffer the ſame Cauſes, they are at length digeſted,

digeſted, prepared and diſcharged, like the former.

(3.) That the Fibres[7], Membranes, Tendons, Cartilages, and Bones[8] of Animals, with the Skins, Threads, and more ſolid Parts of Vegetables, are diſcharged out of the Stomach in their natural Form, after the Tincture and juicy Parts[9] have been extracted.

(4.) That by a Diſſolution[10] of animal and vegetable Food in this manner, is form'd a Liquor approaching the Nature of our animal Juices[11], fitted to ſupply their Waſte, and ſupport the whole Body.

(5.) How People are ſuddenly refreſhed[12] and ſtrengthened, after they have been reduced to a languid State by long faſting, by the ſubtil and more fluid Part of the Aliment being inſtantly received by the *Vaſa inhalentia*, or ſmall reductory Veins which open into the Mouth, *Oeſophagus*, and Stomach, and diſcharge themſelves into the lymphatic Veins, from whence it paſſes immediately into the ſanguiferous Veins, and is afterwards diſtributed by the Arteries thro' all Parts of the Body, and ſuddenly refreſhes or recruits the whole Animal.

[1] If the Food is not well divided by the Teeth, and diluted by the *Saliva*, it paſſes thro' the Body whole and indigeſted. If the ſtrongeſt Man in the World ſhould ſwallow dry Currants whole, he could not digeſt them, but they would be diſcharged entire in his Fæces but little altered; and even ſo ſtrong an Animal as the Horſe, does not ſo perfectly digeſt his Oats, but that frequently ſome of them will retain their vegetative Power, ſo as to grow.

[2] While the upper Orifice of the Stomach is cloſed, by the Contraction of the muſcular Fibres in its upper Part, below its opening into the *Pylorus* is ſtopt by a diſtinct Valve. Since

[3] Since Glaſs itſelf is ground ſmooth by the Attrition of the Coats of the Stomach, the Effect of that Attrition will be much greater upon Animal Food. *Pyerus* found that Iron was not corroded in the Stomach of an Ox; and *Borelli* made the ſame Experiments. The Diſſolution of the Aliments is alſo in part promoted, whilſt they are inſenſibly attenuated by the Interpoſition of a diluting Fluid, in which the nouriſhing Particles or ſolid Elements are ſuſpended.

[4] The Food after a long Maſtication looks white, and reflects the Rays of Light unalter'd; even if a Perſon ſhould eat red Beet and brown Bread, the *Chymus* of it made in the Stomach is always of an Aſh-colour, occaſion'd by the Levigation and ſmooth Surface of the Parts; by which means the maſticated Aliment is ground finer in the Stomach, and reduced to a more uniform Mixture; but the Chyle is never vomited out of the Stomach, nor found in it of a perfect white Colour.

[5] The more the Stomach is diſtended, the more it is compreſſed by the Action of the *Diaphragm*, and the Contraction of the muſcular Fibres of the Stomach itſelf, if they were not over diſtended; but the compreſs'd Aliment endeavouring to eſcape, will paſs out where there is is the leaſt Reſiſtance, not at the *Oeſophagus*, becauſe that is ſtrictly cloſed and contracted by the *Diaphragm*, with the Reſiſtance of the Weight of the Aliment itſelf; the Aliment will therefore paſs out of the Stomach thro' the *Pylorus*, which is relaxed to receive the Aliment, and eaſily tranſmits it thro' its large Aperture, which is yet not ſo open as to admit the more groſs and ſolid Parts, but only the more fluid, which are of the Conſiſtence of Cream, preſſed out by the Force of the *Diaphragm* and Contraction of the Stomach, which overcome the Reſiſtance of the *Pylorus*; from whence they paſs thro' a nar-

row

row Aperture to the *Duodenum*, where the groſſer Parts are more intimately diſſolved.

[6] When the Stomach is full it cannot diſcharge any of the groſſer Part of the Food; therefore ſuch Parts as cannot paſs thro' the narrow *Pylorus*, are retained in the Stomach, and drained of their Juices, tending towards the *Duodenum*; till being at laſt ſufficiently attenuated, they alſo are preſſed through the relaxed Orifice of the *Pylorus* by the Contraction of the Stomach and *Diaphragm*. Dr. *Wallis* has demonſtrated by Experiments, that the Aliment which is firſt taken into the Stomach, is alſo firſt expell'd out of it into the Inteſtines; but the Time required by the Stomach to make ſuch a Diſcharge cannot be accurately determined.

[7] The ſtrongeſt Man does not entirely diſſolve the more ſolid Parts of the Aliment, nor change them into Chyle; for to diſſolve the ſolid Fibres of Beef into thoſe primary ſmall Particles of which the Fibres were originally formed, would require the Action of a greater Power than that by which thoſe Particles were formed into Fibres; but it is evident ſuch a Power is not preſent in the human Body, nor is any other Part of the Aliment digeſted beſides the Juices, which are drained out of the divided Veſſels and hollow Fibres of the Parts of Animals and Vegetables, which Juices are afterwards chang'd to the Nature of the animal Fluids; but ſuch Juices make up much the greateſt Part of all Fleſh-meats, equalling ſeven Parts out of eight of the whole Subſtance.

[8] It has been the Opinion of many, that even the Bones of Animals were diſſolved and ground in the Stomachs of ſome Creatures, as *Helmont* was formerly of opinion, and as I myſelf once imagined; but to be ſatisfied in this Reſpect I made ſeveral Experiments, by which it appeared that the more

more tough Parts of the Aliment are not diſſolved in the Stomachs of Animals. I gave the Guts of an Animal to be ſwallow'd by a hungry Dog, who devoured them inſtantly with hardly ever touching them by his Teeth; they were diſcharged not in the leaſt digeſted, but entire by him, trailing after him out of the *Rectum* in a miſerable manner. To another hungry Dog was given butter'd Bones, which were diſcharged unaltered in his *Fæces*. The furfuracious Part of Bread is alſo diſcharged entire, no Part of it being digeſted but what is diſſolvable in Water; and the ſolid Fibres of the Fleſh of Animals are return'd whole, only drain'd of their Juices. Ligaments which were given to a Dog, were diſcharged without Alteration, after ſtaying three Days in him; and in that kind of the Dog's Feces which is called *Album græcum*, Fragments of Bones were diſcernible to the naked Eye not much altered, the whole Subſtance being no more than the ſmall Particles of Bones which were broke aſunder by the Teeth of the Dog, and exhauſted of their ſucculent Parts.

[9] The Horſe, who is an Animal not much ſtronger than a Man, living upon Graſs and Hay, diſcharges the entire Leaves of Graſs and Stalks of Hay, viſible to the naked Eye, after they have been macerated in his Stomach, drained in his Inteſtines, and turned to dry Balls of Dung. The Ox, who ſwallows the Graſs greedily in little Balls, never diſſolves it in his firſt Stomach, but is oblig'd to ruminate the ſame and grind it again by the Teeth, which being attenuated and macerated by the *Saliva*, afterwards ſwallowed, and the Maſtication again repeated, yet the entire Stalks and Fibres of the Graſs and Hay are no leſs diſcernible in their Feces; in human Feces the ſolid Fibres of Fleſh are alſo diſcernible; and the ſame alſo holds

true

true of the ſolid Parts of Vegetables, the Skins of Peas, Beans, Cherries, Currants, Grapes, *&c.* for all thoſe are diſcharged, ſwelled indeed, and mollified, but not attenuated and diſſolved.

[10] An eminent Phyſician has ſtarted the Queſtion, why the human Stomach is not wore away itſelf in the Diſſolution, which it makes of the Stomachs and Inteſtines of thoſe Animals upon which we feed; but the Anſwer is not ſo difficult as that Gentleman imagined; for the human Stomach is impaired by the ſame Heat, and the ſame Trituration which is ſuffered by the Aliment, but then it is perpetually renewed, which the Parts of the Aliment are not. Such Parts of the Aliment as are incapable of being diſſolved by the Action of the Teeth, *Saliva*, Mixture of the Air and the Juice, Heat, and Attrition of the Stomach, ſtay in that Viſcus till they are drained of their moſt fluid and moveable Particles; and then the Stomach is relaxed, and the *Pylorus* is more inclined downwards; ſo that by the Preſſure of the *Diaphragm* they are at laſt alſo expelled, thro' the relaxed *Pylorus*, except they ſhould be vomited up with a ſtimulating acid or putrid Vapour.

[11] It is a ſurpriſing and almoſt incredible Change in the Nature of Things, that the very ſame Chyle ſhould be made as well from the different vegetable as animal Food; but if we conſider the Matter a little more attentively, we ſhall find all Animals reducible to two Kinds. (1.) Thoſe which live upon Animals. And, (2.) Thoſe which live upon Vegetables. In the latter Claſs of Animals, which are moſt frequently in uſe for Food amongſt us, their animal Juices are the Juices of Graſs, and other Vegetables, prepared by the Efficacy of the Stomach, Inteſtines, and Liquors flowing into them: But in the carniverous Claſs of Animals, their Fluids

are

are vegetable Juices firſt converted into animal Fluids by grameniverous Animals; and now again tranſmuted into another more exalted kind of animal Juices. All our Nouriſhment is therefore vegetable Juices, prepared by the Action of one or more Stomachs, according as they are drawn either immediately from the Vegetables themſelves, or from the broken Fibres and Veſſels of Animals: So that the Fluids of thoſe Animals which feed upon Vegetables approach nearer to the Nature of vegetable Juices; whereas in carnivorous Animals they are more exalted and attenuated, as thoſe vegetable Juices undergoing the Action of the natural and vital Organs of two Animals, are alſo more inclined to be alcaline; and therefore the Milk of Bitches and She-Lyons does not eaſily turn ſowr. In the ſame manner our Fluids are formed out of the Juices of the Parts of Animals upon which we feed, and are again digeſted, and more exalted by the Action of our *Viſcera*; if we therefore conſider, that every thing which we eat is really vegetable Subſtance, either at firſt or ſecond hand, as having undergone the Action of one or more Stomachs, it will be no ſuch difficult Matter to conceive that the ſame Blood ſhould be made out of the ſeveral Kinds of Food.

12 The firſt Father of Phyſick, *Hippocates*, has told us formerly, that all the Parts of the human Body are perſpirable; or which is the ſame, are every where furniſhed with exhaling Arteries and abſorbing Veins. An infinite Number of ſmall Arteries diſperſed thro' the whole Skin, exhale an inviſible Vapour, by which we are encompaſs'd as with a Cloud, and which is carried off from us by the Air; if this be condenſed againſt the Side of a Looking-glaſs, it turns into watery Drops; this Vapour is never perceived in hot Weather, nor under the Tropicks; but in a cold Air it is condenſed

into viſible Clouds, ſo that we breathe out a ſenſible Vapour as well from all Parts of the Body as the Mouth: This Tranſpiration is very much diminiſhed by a denſe Cuticle, and the repelling Force of a cold Air; upon which account it is probable that this Vapour exhales in much larger Quantities in the internal Cavities of the Body, which are all kept moiſt with theſe Vapours; but if we are thus aſſured that there are exhaling Veſſels which diſcharge theſe Vapours, we are not much leſs certain that there muſt alſo be *Vaſſa inhalentia* to draw in Effluvia at the ſame Parts; which is confirmed by Experiments. *Bellini* having filled an inverted Stomach with Water, found it was abſorbed, ſo as to diſtend the Veins of the Stomach, and the Skin itſelf of the human Body will abſorb the Water retained in a Veſicle formed by a Separation of the Cuticle in a Bliſter. The Particles of *Mercury* and *Cantharides* are alſo abſorb'd, upon their Application to the Skin of the human Body, and diſtribute their Action thro' every internal Part: And the Experiment of *Ruyſch* is ſtill a ſtronger Argument, by which the Injection being forced thro' the Valves of the Veins, paſſes thro' the ſmall Veins into the Cavity of the Stomach in as large or a greater Quantity than what paſſes by the Arteries. I had alſo an Opportunity of obſerving the ſame in the Hand of a Child, where the Injection tranſuded thro' the innumerable ſmall Pores of the Veins like Dew. To theſe abſorbing Veſſels, is owing that Refreſhment which is ſo ſuddenly perceived in the Maſtication of our Food; which ſeems to favour the Aſſertion of *Paracelſus*, that the ancient *Sophi*, or wiſe Men, lived only by chewing their Food, without ſwallowing any Part of it. A-kin to this is the common Story of *Democritus*, who at a Hundred and five Years of Age, is ſaid to have been kept alive

alive the Space of three Days by the Vapour or Scent of new Bread, that he might not dye within the Time of the Feaſt of *Ceres*, and diſturb their Ceremony. However, we have no room to doubt that there are very ſmall abſorbing Veins, which convey the moſt ſubtle and vapoury Parts of the Aliment into the lymphatick Veins, from whence they are tranſmitted to the ſanguiferous Veins, thence to the Heart and Arteries, and by them in a little time to the Brain itſelf; upon which follows a ſudden Recreation of the whole Body.

§. 88. From hence we may judge, whether *Heat* [1] is the only Author of Digeſtion in the Stomach? Whether there is *a vital Acrimony or Spirit* [2] which inſpires a native Action to the Stomach? Whether Digeſtion will be imperfect without, or promoted by *an acid* [3]? Why a *viſcid, ſaline, acid or bitter Humour* [4] is often belched up by a healthy Man, upon ſtooping when his Stomach is empty in a Morning? And from whence they proceed? Whether there are more Cauſes than one, and what, to excite *Hunger* [5]? Why the Stomach is frequently *tumefied* [6] in digeſting the Aliment? And why at times there is occaſion'd a Difficulty of Breathing, Fluſhings of the Face, and Lazineſs of the Body? Why the *Omentum* [7] is connected to that Part of the Stomach, which, upon its Diſtention, is elevated and applied to the *Peritonæum*? Of what Service is the large Quantity of Fat which adheres to the umbilical Vein, incumbent upon the Stomach? And how well the manifold Action of

the Stomach is intelligible, by conſidering how far it is concerned as a Veſſel to receive and retain the Food, afterwards by mixing the ſeveral Fluids which paſs into the Stomach, and, by acting upon the Air, and then, as it performs the Office of a hollow Muſcle, and a Veſſel in *Balneo*; and laſtly, as it communicates and receives the Concuſſions or Agitations of the adjacent Parts.

[1] The generality of Phyſicians after *Galen*, have attributed the Digeſtion of the Aliment in the Stomach only to Heat, comparing that Organ to a Pot, heated (inſtead of a Fire) by the Heat of the Heart, Liver, and Spleen; but thoſe Notions have been well refuted long ago by *Helmont*, eſpecially by his firſt Argument, that the Blood of the moſt voracious Fiſh is very little warmer than the Water itſelf, in which they live: But Fiſh digeſt their Food in a different manner from Men, for their Aliment ſtays a long time in their Stomach, and diſſolves very ſlowly; they have alſo a very large Quantity of Bile; and in general, the more Fiſh breathe, the leſs Bile they have; beſides, ſmall Fiſh devour'd by other voracious ones, are the more readily digeſted, as they naturally putrify and diſſolve into a *Mucus*; nor was the Food ever obſerved to be digeſted into Chyle barely by Heat, becauſe that is very ſtrong in Fevers, in which the lighteſt Aliment is ſcarce digeſtible; not to mention many other Arguments which might be drawn from the Nature of the Thing itſelf.

[2] This is a falſe Notion of *Helmont*, which was receiv'd by *Sylvius*, and the generality of the *Chemico-Carteſian* Sect; to wit, that the Digeſtion of the Aliment is performed by the Power of an acid Ferment;

Ferment; which Acid is of a very different Nature from any chemical or vegetable Acid, being peculiar to the human Body only: And that by the Action of this Ferment the Food is turned to Chyle, and receives the vital Impreſſion from the Soul, which was imagined to reſide in the Stomach; alſo that this Acid was conveyed from the Spleen to the Stomach by the *Vas breve*. Thus, for Example, ſay they, Gold is not diſſolved by any acid Spirit, but the Spirit of common Salt only; which however will not diſſolve Silver, *&c.* But the Arguments to confute this Notion are almoſt infinite, the *Vaſa brevia* are Veins which convey Blood from the Stomach to the ſplenic Vein, but return nothing from the Spleen to the Stomach; beſides, the Blood is far from poſſeſſing any Acid, its Salts are of the neutral or ammoniacal Kind, and all the Juices ſeparated from the Blood, except Milk, afford a volatile alcaline Salt only; alſo a perfect Fermentation was never yet obſerved in the Stomach. The Falcon, Eagle, Wolf, and other voracious Animals, are repleniſh'd more with an alcaline then an acid Juice. And I myſelf have obſerved a diſſolved Fiſh ſwimming in a kind of alcaline, fœtid, and mucous Pickle in the Stomach of a Dog-fiſh. The *Caſſowar*, a Bird more voracious than the *Oſtrich*, is found to have no Acid in its Stomach, but a muriatic Liquor; and Men who are never troubled with any acid Belchings, have a ſtronger Appetite and better Digeſtion than others. Upon opening the Stomachs of Animals who have faſted two Days, the Liquor found therein is mucous, ſaline, ſharp, and bitter, being compoſed of the *Saliva*, Bile, and pancreatic Juice; alſo in hungry Men in Health, there is a Liquor often regurgitated, not acid, but ſalt and bitter, which occaſioned *Celſus* to ſay that Bile is increaſed by faſting.

[3] Acids are not ſo pernicious to the human Body as many of the Moderns have imagined, and their Acrimony is quickly overcome by the Addition of any alcaline Salt. Thus *Homberg* demonſtrates, that five Ounces of the ſtrongeſt Vinegar does not contain more than three Drams of acid Salt; for by ſaturating that Quantity with an Ounce of Salt of Tartar, the neutral Salt produced from them both, weighed only an Ounce and three Drams, the reſt being ſimple Water: Yet Acids aſſiſt the Appetite ſo far, as they deſtroy any alcaline Rancidity which might pall the Stomach; but if a Loſs of Appetite proceeds from a Weakneſs of the Bile, then Acids are hurtful, and Alcalies uſeful, particularly the *Sal. Vol. oleoſ.* of *Sylvius*, Tincture of Myrrh, Extract of Wormwood, and the like, *&c.* But if Viſcidity is the Cauſe, then all Kinds of Salts promote the Appetite and Digeſtion, whether they be acid, alcaline, or medial; therefore Acids will not always reſtore the Appetite; nor can an acid Ferment be demonſtrated from an Acid having ſometimes that effect.

[4] In a Man that has faſted longer than uſual, after riſing out of Bed in a Morning a bitter yellowiſh Juice will riſe into his Mouth, if he ſupp'd upon Fleſh or fat Meat; but an Acid, if he made his Supper upon Milk or vegetable Food; which mucous Liquor will alſo riſe into his Mouth more eaſily upon ſtooping, and removing the Reſiſtance from the perpendicular Weight of the Fluid; the Bitterneſs of it proceeds from the Bile, which *Celſus* has long before obſerved to come into the Stomachs of faſting People. The ſame alſo happens in Brutes, from a Mixture of the Bile, Juices of the Stomach and *Pancreas*, together with the Relicks of the Food retained in the Stomach, which are expelled upward by the Preſſure of the abdominal Muſcles, whenever the Mouth

Mouth of the *Oeſophagus* is more open than the *Pylorus*, or when the latter is cloſed or contracted.

[5] The Senſation which we call Hunger is ſomewhat ſurpriſing; it is not the ſame as Pain, and yet it gives equal Uneaſineſs, being ſometimes ſo violent as to compel Mothers to kill and eat their own Children for Food. This uneaſy Senſation was wiſely beſtow'd by the bountiful Creator upon Mortals, to inform them of the great Danger and Injuries which the Body would undergo, particularly the Fluids of it, by continual motion, which would quickly become acrimonious and alcaline, ſo as to deſtroy the whole, if they were not frequently renewed and diluted with freſh Chyle. It is alſo another Providence of the Creator, that we have not an Appetite for Food in Diſeaſes, when the Powers of Digeſtion are too weak to operate upon the Aliment. Another conſiderable Uſe of Hunger, is, for reſtoring the Conſumption of the Fluids, made by the *Sanctorian* Perſpiration, and other Excretions; theſe are the Ends for which we have an Appetite to Food: but the Cauſes thereof are various; as firſt, the perpetual Attrition of one Part of the empty Stomach againſt the other; whence the nervous *Papillæ*, plentifully diſperſed thro' its *Rugæ*, receive an uneaſy Senſation. Secondly, the ſharp Quality of the Liquors which paſs into the Stomach, ſuch as the *Saliva*, *Succus gaſtricus*, and ſometimes the Bile and pancreatic Juice, by their retrograde Paſſage into the Stomach. Thirdly, the Relicks of the laſt Meal retained in the Stomach, and degenerating into an acrimonious Ferment; for the Stomach is never entirely emptied (*per* §. 83.) ſome Part of the Aliment will therefore remain in the Interſtices of its *Rugæ*, and vellicate its nervous *Papillæ*. Hunger is removed, 1. By filling the Stomach with

new Food, which is the Intention of Nature. 2. By diluting and diſcharging the acrimonius Fluid and Relicks in the Stomach by warm, watery, and oily Liquors. 3. By violent Paſſions of the Mind, and Frights. If you ſhould convey one Grain of a rotten Egg into the Stomach of an hungry Perſon, his Appetite will be gone in a Moment, and a Vomiting will follow, whereby what was offenſive to the Stomach, will be rejected from it

[6] This Tumefaction of the Stomach proceeds from the Fermentation or Putrifaction, whereby the Particles of Air included in the Aliment are ſet at liberty, and reſtored to their Elaſticity.

[7] The *Omentum* is thus connected to the Stomach, that it might interpoſe between that and the *Peritonæum*, leſt the diſtended Stomach ſhould be injured by the Preſſure or Reſiſtance of the *Abdomen*, which is by this means commodiouſly prevented by the Softneſs of that fat Body.

§. 89. When the Stomach is almoſt empty, it contracts, grows flaccid and wrinkled, retaining only the groſſer Parts of the Aliment, which at length are alſo expelled by the Force of the *Diaphragm* in Reſpiration, while the *Pylorus* is relaxed; yet the Stomach is ſeldom entirely emptied, ſo far as not to retain ſome Part of the Aliment, and not be capable of receiving more, without Diſtention.

The Remainder of the Aliment frequently ſtays a long time in the Stomach; the groſs Parts of the Food were found in the Stomach of a Hog after they had been eat three Days; this is occaſioned much by the narrow Orifice of the *Pylorus*, which is hardly wider than a Gooſe-quill; therefore many

ny Diſorders of the Stomach may be remedied barely by faſting twenty-four Hours, eſpecially if a large Quantity of warm Emulſion or ſalt Water be drank afterwards, whereby the Stomach and Bowels will be cleanſed.

Concerning the Action of the Inteſtines on the Aliment.

THE Inteſtines perform more exactly the Attenuation of the Aliment, which was before begun in the Stomach; the ſmall Inteſtines only form and ſeparate the Chyle from its excrementitious Part, while the large Inteſtines receive, change and diſcharge the groſs excrementitious Part of the Aliment; for the Chyle is never found in the large Inteſtines, naturally, nor the fetid Excrement in any of the ſmall ones. In examining the Action of the Inteſtines upon the Aliment and Fæces, we are to conſider them, 1. As a Canal, receiving and retaining the Food. 2. As a ſecretory Organ, conveying various Fluids, to be mixed with the Aliment in them. 3. As a hollow Muſcle, agitating and compreſſing the Food. And laſtly, 4. We are to conſider the Alterations ſuffered by the Chyle in the Inteſtines from the Action of the adjacent Parts; to which we may add, the Alteration made in them by the Bile and pancreatic Juice.

§. 90. To underſtand what happens to the Chyle of the Stomach, and its Fæces, in the Inteſtines, we ought firſt to conſider the Structure of that membranous Tube, the ſeveral

Juices

Juices conveyed into it, the abſorbing Veſſels, which convey the Chyle from it, with its own vermicular Motion, and that received from the Preſſure of the circumjacent Parts.

§. 91. The firſt and internal Coat of the ſmall Inteſtines, which immediately imbraces the Chyle, is villous, rough, and full of *Papillæ* [1], of *a gray or aſh Colour* [2], perforated with many ſmall *Tubes* [3], diſcharging an aqueous and a viſcid Liquor into them; it is alſo perforated by the Mouths of the lacteal Veſſels, and ſome *large Pores* [4], diſtinct from all its others; it is three times as long as the nervous Coat, by which it is inveſted, eſpecially in the Inteſtine called *Jejunum* [5], where riſing up in Duplicatures, it forms Valves, and is full of Wrinkles, eſpecially where it is connected to the Meſentry; the external or convex Surface of this Coat is full of ſmall Glands, Veſſels, and Nerves. By this Structure of the innermoſt inteſtinal Coat; the Chyle and *Fæces* are *retarded* [6], and continually intercepted in their Paſſage, its internal Cavity is *lubricated* [7], and defended, and the groſſer Parts of the Chyle conſtantly diluted; where the fecal Part of the Chyle becomes more inſpiſſated and hardened, it is there moſt lubricated, eſpecially towards the End of the *Ilium* [8], where the exquiſite *Senſation* [9] of the lacteal Orifices makes their Sphincters *contract* [10], and exclude ſuch *acrimonious* [11] Parts as would be injurious to the Blood, Lymph, and internal Parts of the Body; by which Irritation the Inteſtines are

alſo

alſo excited to contract and drive forward their Contents.

[1] If a freſh Stomach or Inteſtine be turned inſide out, ſo as to render the villous Coat conſpicuous, by waſhing it and ſuſpending it in warm Water, the whole Surface of that Coat appears beſet with *Papillæ* ſticking out; theſe in the Preparations given me by *Ruyſch*, are ſome of them of an Aſh-colour, others red, whitiſh, or nervous, and appear like a Rug: between the *Villi* of this Coat terminate the ſmall Arteries, Veins, Nerves, and lacteal Veſſels.

[2] They are indeed of a cineritious Colour in a healthy State, but in Inflammations and Injections of the Veſſels, which is a kind of artificial Inflammation, they appear red.

[3] Thro' which the ultimate ſmall Branches of the Arteries diſcharge their Liquor into the Cavity of the Inteſtines, where their Openings are ſo numerous, that there is hardly any viſible Point which does not contain ſome of thoſe Pores and Openings of the excretory Ducts.

[4] Theſe were diſcovered about 40 Years ago by *Ruyſch*, while he was waſhing an human Inteſtine, which he before had injected in warm Water, at which time he perceived remarkable large Pores in the villous Coat of the Inteſtines, which had till that time lain concealed from him. From a ſtrict and repeated Examination of theſe Pores by myſelf in the Preparations of *Ruyſch*, they appear to be Follicles or Cells, into which the Arteries depoſit their ſalival Juice, which by ſtagnating there, becomes more viſcid, till it is at laſt expreſſed, for the Uſe of the Inteſtine or Aliment, by their vermicular Motion and Preſſure. The whole internal Surface of the Inteſtines is conſtantly

ly moiſtened by this Liquor, and if it be wiped off, it is quickly renewed again, either of itſelf, or by a gentle Preſſure.

[5] The internal Coat, above the Inſertion of the *Ductus communis Cholidocus*, is almoſt three times as long as the nervous Coat; below the Inſertion of that Duct it is ſix times as long; and in the *Jejunum*, according to *Feldman*, it is nine or ten times longer, eſpecially when the nervous Coat is contracted by the Cold and its Elaſticity; but the villous Coat being conſtantly flaceid, and ſo much longer than the nervous, is by the Action of that Coat drawn into Wrinkles; which are the larger, as the Inteſtines are leſs diſtended; but when ſtretch'd with Wind, they diſappear: at the End of the *Jejunum* theſe *Rugæ* grow leſs, and the villous Coat alſo becomes thinner; but the *Rugæ* are largeſt on that ſide connected to the Meſentery, being formed into larger Pleats, by the Smallneſs of the Curvature there, and ſtronger Contraction: theſe *Rugæ* are not circular, but make up about a quarter, or a third Part of a Circle, the remaining Part of the Circle being ſupplied by other *Rugæ* at ſome diſtance; by which means the Cavity of the Inteſtine is divided into as many ſmall Cells as there are *Rugæ*, or *Valvulæ conniventes*, thro' each of which the Chyle is ſucceſſively tranſmitted. In this Coat are ſituated mucous Drains or glandular Cells, which more properly belong to the nervous Coat.

[6] The Aliment being intercepted by the *Rugæ*, or Valves of the Inteſtines, is agitated, attenuated, and retarded in its Progreſs, that it might not paſs thro' the Body before it is ſufficiently drained by the Mouths of the Lacteals. If it were not for theſe *Rugæ*, the Aliment would run thro' the Body with little or no Alteration, producing a *Lien-*

tery.

tery. It is by the Efficacy of theſe Valves, that 5 Quarts of *Spaw*-water being drank in a Morning, do not diſcharge any Part by Stool; but being entirely abſorbed by the Veſſels, return into the Blood, and paſs off by Urine. I knew a Gentleman who drank ſeven Pints and a half every Day, and yet he had ſcarce a Stool in a Week; from whence it appears, that the Inteſtines of a healthy Perſon are contracted, and more readily tranſmit their contained Juices into the Blood by the Veins, then diſcharge them by Stool.

[7] The vermicular Motion of the Inteſtines never ceaſes whilſt there is any Life remaining in the Body; and even when they are taken out of the *Abdomen* after Death, they have been obſerved to creep or move upon a Table; the ſenſible *Papillæ* in their villous Coat are therefore conſtantly rubb'd againſt each other; and if they were not defended by the *Mucus* diſcharged from the *Cryptæ* and ſmall Glands, it would produce an intolerable painful or uneaſy Senſation. Therefore provident Nature has carefully furniſhed the whole Surface of the Inteſtines with a *Mucus*, which tranſudes thro' every Point of their internal Coat, that the nervous *Papillæ*, and other Parts, might not ſuffer too ſtrong an Attrition from the groſſer Parts of the Aliment. Nature has wiſely placed the ſmall Glands, for the Separation of this *Mucus*, under the muſcular Coat of the Inteſtines, by which Mechaniſm their Contents are expreſſed when moſt wanted, by their periſtaltic Motion; upon the Ceſſation of which they are again filled; but when this *Mucus* is injudiciouſly abraded, by the unſkilful Exhibition of a violent Medicine, a Dyſentery is produced, and the Roughneſs of the Aliment gives intolerable Pain, frequently followed with an Inflammation or Mortification.

[8] The

[8] The moſt fluid Part of the Aliment, which paſſes out of the Stomach into the Inteſtines, is quickly drained off by the Lacteals in the *Ileum*, by which means it would become ſo indurated, as not to paſs eaſily thro' them, if it were not for a Juice which perpetually diſtils into them from the exhaling Arteries; which diluting and mixing with the Chyle, renders it more fluid, moveable, and capable of tranſmitting its moſt ſubtil Parts into the bibulous Lacteals. Theſe exhaling Arteries are principally ſeated in the firſt Part of the ſmall Inteſtines; but where they terminate, the ſmall Glands of *Pyerus* become gradually more numerous; from both which is afforded a thin *Mucus*, to dilute the Chyle and lubricate the Inteſtines. In the large Inteſtines theſe mucous Glands are alſo very remarkable, affording a much thicker *Mucus*, for the Lubrication and Defence of their villous Coat; and that the Quantity of Juice tranſmitted by them into the Inteſtines is very conſiderable, may be concluded from the Quantity of Water which paſſes by Injection thro' the meſenteric Artery into the Inteſtines in a ſhort time, and from its being the moſt extenſive ſecretory Organ of the whole human Body; as alſo from the large and ſurpriſing Quantity of Water evacuated by the ſame Organ in Diarrhæa's, and by virtue of cathartic Medicines.

[9] The exquiſite Senſibility of this Part proceeds from the great Number of nervous *Papillæ* diſperſed thro' it, upon which account People are quickly carried off by Inflammations and Excoriations of the Inteſtines; and when attended with the moſt acute Pain, will kill the ſtrongeſt Man in the ſhort Space of an Hour. To this Structure is alſo owing the great Senſibility of the Stomach and Inteſtines, whereby they are enabled to diſtinguiſh pernicious

pernicious and poiſonous Subſtances from good Aliment, the firſt uſually producing violent Convulſions and Irritations, whereby they are ejected upwards and downwards.

[10] The Acrimony which the Fæces contract within the Space of twenty-four Hours is ſo great, as to excite the Parts to an Expulſion of them, notwithſtanding the greateſt Reſtraint of the Mind to the contrary.

[11] Every Part of the human Body is ſo wiſely contrived by the great Architect, that the ſmall abſorbing Orifices and Sphincters of the lacteal and other Veſſels, contract their Openings upon the Approach of any acrimonious Subſtance; ſo that they will not admit any offenſive or ſharp Liquor. The Skin upon the Approach of cold Air is contracted into innumerable little Tubercles, like the Skin of a Gooſe, whereby the perſpirable Matter is obſtructed thro' a Contraction of the exhaling Orifices. The Bladder for Urine is ſurpriſingly contracted upon the Contact of an acid Spirit, or the Point of a Needle; but the ſame contractile Power was more neceſſary to no Part of the Body than the Inteſtines; for without that they would give a free Admiſſion to noxious Particles into the Blood, whereby the whole Body would be infected, and its Fluids corrupted; but to prevent that, we learn from the Experiments of *Wepfer* and *Pyerus*, that upon touching them with the Oil of Vitriol they contract like little Worms. From no more than a Defect or Abſence of the *Mucus* lubricating the Inteſtines, the dry Feces will meet with ſuch a difficult Paſſage, as not to be capable of being diſcharged, but the Inteſtine is contracted, and occaſions the Iliac Paſſion. After taking of Arſenic, the Parts which are firſt in contact with the Poiſon, are violently contracted, and thence

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the Air is retained forcibly in the Stomach, ſo as to produce enormous Swelling and a Gangrene in that Viſcus. It is by the ſame contractile Power, exerted by the abſorbing Veins, that the Arteries diſcharge and pour forth their diluting Liquor into various Cavities, Tears in the Eye, *Saliva* in the Mouth, *Mucus* in the Inteſtines, and other Parts, ſerving to defend the tender Fibres from the Action of the Air, and foreign Bodies, alſo to moiſten and keep them fit for motion. If a Man ſhould by Accident have taken a Quantity of *Scammony*, his Inteſtines will quickly perceive the Acrimony of that Reſin, which diſſolves the Blood into a putrid Maſs with the ſame Force as *Mercury*; the ſeveral Fibres therefore and ſmall Veſſels of the Inteſtines will be ſtrongly contracted, diſcharging a large Quantity of Juices to dilute the acrimonious Body, whereby it will be eaſily drove forward and expell'd, as pernicious to the Body. We barely relate theſe Appearances, without accounting for their Cauſes by latent Properties.

§. 92. The preceding villous Coat is inveſted by a thinner vaſcular one, which encompaſſes the firſt *every where* [1], excepting the Valves, this Coat being not valvular, but conſiſting of an Intertexture of innumerable ſmall *Arteries and Veins* [2], which terminate partly in ſoft and pulpy Penicilli, in the form of a ſmall Bruſh *Pencil* [3], partly into the ſmall Glands of *Pyerus* [4], and partly into the ſmall excretory Ducts, diſperſed thro' the Cavity of the Inteſtines; it is alſo furniſhed with *Veins* [5], whoſe Extremities are either continued to the preceding Arteries by Inoſculation, as a continual

nual Tube, or are ſpent in the ſmall Glands of *Peyerus*, or elſe open, with ample bibulous Orifices, into the villous or downy Subſtance lining the Inteſtines; to theſe Veſſels is alſo added a *nervous Intertexture* [6], to which the Glands of *Peyerus* are connected near their Roots, and are advantageouſly placed under the muſcular Coat of the Inteſtines, to diſcharge their Mucus by Ducts opening thro' the villous Lining; theſe Glands are but few in Number in the two firſt of the ſmall Inteſtines, but become larger, more numerous, and cluſtered together towards the beginning of the larger Inteſtines; their Office is therefore to dilute the *Fæces*, lubricate and moiſten the internal and ſenſible Fibres of the Inteſtines, defend them from the Acrimony and Roughneſs of the *Fæces*, and adminiſter a digeſtive *Heat* [7] to their Contents.

[1] The ſecond Coat of the Inteſtines is not extended between the *Rugæ* of the firſt or internal Coat of them, but is only extended over the ſame in an equal Cylinder.

[2] The Inteſtines are ſo very full of ſmall Veſſels, that, one wou'd be perſuaded they were nothing elſe, from inſpecting ſome Preparations of them given me by *Ruyſch*; one wou'd take them to be nothing but Arteries, if they only were fully diſtended; and for nothing but Veins coming from the *Vena Porta*, if they were injected by that Veſſel at the Liver, or coming from the *Vena Cava*, if the Injection was thrown in by that Veſſel; and by theſe numerous Veſſels ſpent upon the villous Coat is preſerved the Heat of the Inteſtines.

[3] When a ſmall Branch of an Artery, diſtributed to the nervous Coat of the Inteſtines, comes to terminate, it is ſuddenly ſubdivided into an infinite Number of other ſmall Twigs, reſembling the Hairs of a Bruſh Pencil ſticking out of a Quill. Theſe *Penicilli* terminate two ways, ſome diſcharging their Liquor into the Cavity of the Inteſtines, others tranſmit their Liquor to the ſmall Glands of *Peyerus*, which retain it till it becomes more inſpiſſated before it is diſcharged.

[4] Theſe are very ſmall Cells, receiving a Humour from the Arteries, which is retain'd in the membranous Follicles till they are full, and then diſcharged; the ſmalleſt of theſe Glands inveſt the *Pylorus*, and grow gradually larger, and more aggregated, as they approach nearer the *Cæcum*; becauſe the Chyle is not acrimonious after it is juſt paſſed out of the Stomach, but becomes ſo by its long ſtay; and therefore *Peyerus* does not well conclude the Action of his Glands to be for diluting the Chyle, for they are more numerous where the Chyle is thickeſt and more excrementitious.

[5] There are ſeveral Sorts of Veins which abſorb Liquors from the Cavity of the Inteſtines. 1. Veins from the Meſentery. 2. From the *Cava*. 3. Lacteal Veins. 4. Lymphatic Veins. The Paſſage of Water into the Cavity of the Inteſtines, by injecting it at the meſenteric Artery or Vein, or at the *Vena Cava*, demonſtrate the abſorbing Faculty of thoſe Veſſels.

[6] The Nerves of the Inteſtines are very numerous; but for what End are they thus diſtributed, it may be aſk'd? Whether they do not convey Part of their Juice in the manner of Arteries with their correſponding Veins? And whether the *Reſiduum* is not poured into the Cavity of the Inteſtines in the Form of a Vapour? Both theſe ſeem probable,

ble, tho' they do not admit of Demonſtration. This is certain, that moſt extream and ſudden Weakneſs is occaſion'd by Diarrhæa's. I have had Patients from the *Indies* who have been miſerably extenuated to mere Skeletons by ſerous Diarrhæa's.

[7] Heat from the innumerable ſmall Veſſels which encompaſs the Inteſtines, by the Action of which Heat, being the ſame as (at §. 86. N. 2.) the Aliment continues to be further attenuated and digeſted to a much greater Degree, by the greater Extent of this Organ. The Inteſtines never grow cold whilſt there is any Life in the Body; and as ſoon as ever they are cold after Death, their periſtaltic Motion ceaſes, and the Coats of the lacteal Veſſels collapſe; to this we may add that the Pulſations of the Arteries cauſe a perpetual Attrition of the Chyle in the Inteſtines, different from that occaſioned by their periſtaltic Motion or their Heat.

§. 93. The preceding vaſcular Coat is inveſted by another *muſcular one*[1], conſiſting on its Inſide of thick and ſtrong annular Fibres, inſerted into the Edge of the *Meſentery* as into a *Tendon*[2]; at which Part the Fibres receive their Nerves; by theſe the whole Cavity of the ſmall Inteſtines is, Part after Part, ſucceſſively contracted, the Valves at the ſame time *riſing upwards*[3]; their Contents are alſo reciprocally preſſed *upwards*[4] and downwards, againſt the Side of the villous Coat, according to the Direction of the Inteſtines, by which means the Chyle is ground together, more intimately mixed, attenuated, and prevented from running into *Concretions*[5], at the ſame time deter-

ging the Sides of the Inteſtines. The convex or external Surface of this muſcular Coat is compoſed of *longitudinal Fibres* [6], which run croſs the former, ſerving to contract the Length of the Inteſtines, whereby they are corrugated and ſtraiten'd, eſpecially on that Side annex'd to the *Meſentery*.

[1] A muſcular Expanſion or Membrane, which ariſes from the *Pylorus*, and terminates at the end of the *Ilium*; the Action of which is, to ſhorten the Length of the Inteſtines by its longitudinal Fibres, and to contract their Diameter by its circular Fibres, whereby the Capacity of the Inteſtines is ſo far diminiſhed, as to have no empty Space; the Action of this muſcular Coat is therefore ſtronger than that of the Stomach, for that never applies the Sides of the Stomach cloſe to each other, ſo as to leave no Space in the ſame. The Thickneſs of the muſcular Coat of the Inteſtines is ſo remarkable, that it cauſes the Inteſtines to creep like a Worm, even after they have been taken out of the Animal and laid upon a Table. The ſame Motion is alſo performed in the ſmall Inteſtines of a living human Body by virtue of this Coat, which is quite different from the Motion of them, which frequently ariſes from their being diſtended with Wind, as is ſometimes obſerved in dead Bodies. In all living Diſſections the Inteſtines are conſtantly obſerved in a vermicular motion, being ſucceſſively contracted and relaxed, one Part after another; and that the Relaxation and Diſtenſion of them proceeds from their contained Air and Aliment, but their Contraction from theſe muſcular Fibres. This periſtaltic Motion of the Inteſtines continues even a conſiderable time after the

the Death of an Animal; for upon opening Rabbits, which have been kill'd by breaking their Necks, the Inteſtines continue to creep a long while after they have been pull'd out and thrown away. This Motion is demonſtrated to ſubſiſt in the human Body for the Space of two whole Days after Death, during which time the Chyle paſſes by the lacteal Veſſels; the Effects therefore of this Action muſt be very conſiderable from ſo ſtrong and laſting a Contraction, continued conſtantly thro' ſo long a Tube as the Inteſtines.

[a] A Muſcle is a Subſtance compoſed of red moving Fibres, but a Tendon is a Continuation of the ſame Fibres, which are neither red, nor yet contract; the Fibres of the Inteſtines are therefore muſcular, diſpoſed upon each other in ſeveral *Strata*, the outermoſt of which ſerves as an Integument for the ſeveral included *Strata*; there is no neceſſity that theſe Fibres ſhould appear equally red with thoſe of the larger Muſcles, for Redneſs is not a characteriſtic Mark of a Muſcle, becauſe every muſcular Fibre appears white and pellucid, like a Snail's Horn, after the Blood has been waſhed out with Water; but in the Muſcles of Inſects, even in their natural State, there is no Appearance of Redneſs, notwithſtanding their muſcular Motions are performed with a greater Strength in proportion, than thoſe of the human Body, as *Roberwallius* has demonſtrated in his Treatiſe *de ſaltu Pulicis*. Thoſe muſcular Fibres of the Inteſtines which are annular, become tendonous towards the Meſentery; which has been rightly obſerved by *Willis*, and they afterwards are continued with the Nerves, which are diſtributed to the Inteſtines thro' the Meſentery; and every Muſcle is nothing more than an Expanſion of ſmall Nerves.

[3] The muſcular Coat of the Inteſtines being contracted, and their whole Capacity by that means diminiſhed, there muſt neceſſarily follow a Contraction of their more lax villous Coat into large Folds, which will ſtill further diminiſh and divide the internal Cavity of the Inteſtines; and thus they are divided into as many Cells as there are projecting Valves, formed by the Corrugation of their internal Coat; but when the Aliment endeavours to paſs from one Cell to another, it is retarded, preſſed againſt the bibulous Pores of the villous Subſtance, and its moſt fluid Part is by that means abſorbed by the three Orders or Kinds of Veins; and thus the Aliment will receive a ſecond, third, and more than a hundred ſucceſſive Triturations, Dilutions, and Abſorptions; which will at leaſt be repeated as often as there are Valves in Number. The whole inteſtinal Tube is therefore not always open, but contracted in one Part, and relaxed in another; in which repeated Actions the perſpirable Matter and mucous Liquor of *Pyerus* will be diſcharged in larger Quantities into the Inteſtines at the time of their Relaxation, and intimately mixed with the Aliment at the time of their Contraction; and laſtly, the oily Part of the Blood, which was received by the cellular Coat of the Inteſtines during their Relaxation, is preſſed out in the Contraction of their muſcular Coat, and lubricates every fleſhy Fibre.

[4] We are taught by the repeated Experiments of *Wepfer* and *Pyerus*, that the Inteſtines are not only contracted downwards from the Stomach towards the *Anus*, but alſo in a contrary Direction from the *Anus* towards the *Oeſophagus*, whereby the Aliment is drove back by this vermicular Contraction, aſſiſted in its motion by the Preſſure of the abdominal Muſcles; thus the Aliment receives a very

a very conſiderable *Remora*, or Retenſion, Attrition, Diviſion, and Mixation, by the repeated Actions of this muſcular Coat of the Inteſtines, which not only continues during the whole Life of the Animal, but even after Death, when the Heart has ceaſed to move for many Hours.

[5] A Dram of Turpentine will ſo ſtick to the Fingers and Hands of a Perſon, that it can ſcarce be waſh'd off; but when the ſame is made into Pills, it will not adhere to the Sides either of the Stomach or Inteſtines, and yet it will preſently tranſmit many of its Particles into the Blood, and paſs off by Urine: this extraordinary Effect proceeds partly from the continual Effuſion of ſaponaceous and diluent Juices into the Inteſtines, in conjunction with their periſtaltic Motion, which prevent the leaſt Particle of the Turpentine from ſtaying two Inſtants in one Place; but the exhaling Arteries eſpecially pour out a thin Liquor, by numerous ſmall Ducts, into every Part of the Inteſtines, which repels and waſhes off ſuch viſcid Parts of the Contents, as might otherwiſe adhere too ſtrongly to each other, and to the villous Coat of the Inteſtines; ſo that if the Inteſtines ſhould be deſtitute of this Defence, by an Excoriation, Inflammation, or Suppuration, the Patient muſt inevitably periſh, as no Aliment would then be of any Service to him. The Inteſtines have even been obſerv'd to grow together from thoſe Cauſes, and produce a ſurprizing and fatal Iliac Paſſion; otherwiſe the Fæces are ſeldom obſerved to adhere to the Inteſtines, notwithſtanding they are ſometimes form'd into ſuch bituminous and hard Lumps, beginning to ſtick to the Sides of the *Rectum*, as not to be capable of being diſcharged without the Aſſiſtance of the Fingers, or ſome other Means. And even in the Heart, which performs ſuch a

ſtrong and perpetual Contraction, we frequently find that Polypuſſes are formed by a Coagulation of the more viſcid Parts of the Blood adhering to the Sides and other Parts of that Organ.

'The Mechaniſm of theſe longitudinal Fibres is very particular, they being intermixed with the circular Fibres interſecting them in various Directions, and that chiefly in the ſmall Inteſtines. There is the ſame reaſon for theſe Interſections, as for the tendonous Interſections in the Recti-muſcles of the *Abdomen*, the *Complexi*, *&c. i. e.* that by the frequent Interpoſition of new Tendons, towards which each end of the Fibres are to contract, the Strength of the Muſcles may by that means be increaſed; whereas if the Contraction was to be continued without Intermiſſion through the whole Length of thoſe Fibres, they would quickly be tired by a ſlight Action. We may alſo add, that by the Contraction of theſe longitudinal Fibres, the poſterior Part of the Inteſtines is drawn cloſer towards their anterior Part; the Curvature of the Inteſtines is ſtraitened by them, their internal *Rugæ* increaſed, and their Valves brought nearer to each other; they alſo aſſiſt the Action of the orbicular Fibres, in forming the Cells of the Inteſtines; but their Contraction is not performed at once thro' the whole Tract of the Inteſtines, but unequally, ſometimes in one Part, and ſometimes in another.

§. 94. The preceding muſcular Coat is inveſted externally by the *cellular Membrane* [1], lately diſcovered by *Ruyſch*, being a Continuation of the adipoſe Membrane of the *Meſentery*, very ſerviceable to the muſcular Fibres in their Action, by lubricating them with the contained Oil, and keeping them moveable upon

upon each other, being the Seat of many Diſorders of the Inteſtines and in lean People ſo thin, as to be hardly viſible; and this cellular Coat is again inveſted externally by the outermoſt Integument, continued from the *Peritonæum*, which covers all the preceding, connects the Inteſtines in their convoluted Order to the *Meſentery*, and binds down their Veſſels.

1 The elegant Structure of this Membrane deſerves our particular Attention; in order to which we are to obſerve, that the Meſentery proceeds from a Reduplication of the *Peritonæum*, which paſſing forwards from the *Vertebræ* of the Loins, is reflected back again in the ſame Courſe, ſo as to form two Plains, between the middle of which is contained the Inteſtines; and further backward from the Inteſtines are diſpoſed the Arteries, Veins, Nerves, and lacteal Veſſels, paſſing between the two *Laminæ* of the Meſentery, to and from the Inteſtines. The ſmall Arteries and Veſſels, which are ſpent upon the cellular Subſtance, depoſit an oily Fluid, to be preſſed out again by lubricating the Parts. This cellular Subſtance of the Meſentery forms a ſomewhat fibrous Body, together with the contained Fat interpoſed between the two *Laminæ*. When the two *Laminæ* of the Meſentery have both reach'd the Inteſtines, they depart from each other, and embrace or encompaſs the Body of the Inteſtines. This Structure may be eaſily demonſtrated in a dead Subject that is much emaciated, by making a ſmall Inciſion in the external Membrane of the Meſentery, and inflating the ſame with a Blow-pipe, whereupon the *Flatus* will paſs by Preſſure between the two *Laminæ* of the Meſentery, and even round the Inteſtines, next to their muſcular

muſcular Coat. And in a great Part of the Inteſtines, the two Plates of the Meſentery are firmly connected to their muſcular Coat, moſt ſtrongly to that Part of them which is oppoſite to the Meſentery; but in that Part where the Plates of the deſcending Meſentery firſt apply themſelves to the Inteſtines, there is little or no Coheſion between the muſcular Coat of the Inteſtines and the *Laminæ* of the Meſentery. Alſo in thoſe Parts where the Veſſels of the Meſentery paſs into the muſcular Coat of the Inteſtines, there the cellular Subſtance of the Meſentery alſo inſinuates itſelf together with the Arteries, and paſſes between their external Coat from the *Peritonæum* and their muſcular Coat; and this is the cellular Coat of the Inteſtines which *Ruyſch* diſcovered by Inflation. In Oxen and fat Animals it is the Receptacle for Fat, and is called *Adipoſa*; but in lean Animals, being compoſed barely of the *Laminæ* and an Intertexture of Fibres, it is denominated *Celluloſa*, being of the ſame Nature with the common Adipoſe, or cellular Membrane, which is diſtributed between all the Muſcles. In the Inteſtines indeed it is very thin, in proportion to the thin muſcular Coat underneath; and it is alſo ſo thin in the Forehead, *Scrotum* and *Penis*, that ſeveral Authors deny its Exiſtence there; which is yet demonſtrable in thoſe, partly by *Anaſarca*'s, or hydropic Swellings, as alſo by emphyſematous or windy Swellings, when the Cells of this Membrane are diſtended by extravaſated Fluids. The Uſe of this cellular Membrane is, to lubricate the Veſſels with its oily Contents, keep them flexible and fit for motion, and to prevent the muſcular Fibres from becoming dry, and growing to each other, which they are very apt to do. If a Muſcle is deſtitute of this Membrane, it adheres to the adjacent Skin, or its own looſe Integument, ſo as

not

not to be moveable; but if on the contrary this Membrane is too much diſtended with Fat, the Muſcle then becomes weaken'd, relax'd, and unfit for motion; as is obſervable in Hogs which have been fatten'd for ſix Months together, at which time if they were not to be kill'd, they would be ſo ſtuffed up with Fat, as to be incapable of breathing; and by compreſſing the Veſſels, would intercept the Motion of the Blood and Life of the Animal. This Membrane is alſo the Seat of Tumours, mentioned in the Obſervations of *Bonnetus*, which frequently riſe in the Inteſtines themſelves, ſo as to obſtruct their Capacity. The ſame cellular Membrane ſeems to be alſo inſinuated between the inſide of the muſcular Coat and the internal villous Coat of the Inteſtines.

§. 95. The whole continued and *long*[1] Tube of the Inteſtines beforementioned, is connected to the complicated and wrinkled Edges of the much ſhorter *Meſentery*, ſo as to hang pendulous, in various Convolutions and Folds, in all manner of Directions; they are lubricated, warmed, mollified, and rendered fit for Motion by the adjacent Fat of the *Omentum*[2], which is incumbent on them, and inſinuating between their Convolutions, emits oily and lubricating Vapours, prov'd by undeniable *Experiments*[3], and ſeparating them from the *Peritonæum*, prevents them from adhering to that Membrane and to each other, and defends them during the repeated Contractions and Preſſure of the abdominal Muſcles; the Inteſtines are alſo advantageouſly expoſed to thoſe Parts of the *Peritonæum* which communicate the

the reciprocal Succuſions from the *ambient Parts* [4]: Their Contents in Health being always fluid and *diluted* [5], and growing gradually thicker as they arrive nearer their Exit; being alſo *conſtantly* [6] in ſucceſſive *Contractions* [7] and various Agitations by the periſtaltic Motion, which perpetually exiſts in a ſurpriſing manner in all healthy living Animals. The Inteſtines are therefore exquiſitely adapted to further, grind, *macerate* [8], *dilute* [9], *attenuate* [10], *volatilize* [11] and *ſeparate* [12] the Parts of our Aliment or Chyle, to *preſs* [13] the ſame into the Orifices of the Lacteals, and to *retard* [14] the Paſſage of thoſe Parts, which are yet crude, or half digeſted, till they are more perfectly diſſolved; and theſe Offices are in common to the whole Tract of the Inteſtines indifferently.

[1] The Inteſtines are four or five times as long as the Perſon from whom they are taken, and yet they are folded together in ſo ſmall a Compaſs as the Meſentery, without any Diſtortion, or even Compreſſion of any one of the many thouſand ſmall Nerves and Blood-Veſſels which are ſpent upon them; thus ſurpriſingly are they connected by the Meſentery, which ſuſtains all the Inteſtines in their Convolutions. But the Inteſtines are ſhorter in the living Animal than they appear in a dead Subject.

[2] The fat Body of the *Omentum* is a membranous Bag, compoſed of two *Laminæ*, between which paſs the adipoſe and epiploic Veſſels; it inveſts the Inteſtines down to the Navel, and inſinuates between their Convolutions, ſo as frequently

to

to adhere to them; it every where defends the Inteſtines from being injur'd by the Impulſe of hard Bodies, or by the tenſe *Peritonæum*, between which it is interpoſed; and by keeping them both lubricated, prevents the Inteſtines from adhering to the *Peritonæum*, or to each other; which is apparent from the Inteſtines growing to the *Peritonæum* when the *Omentum* has been cut out. There was a Madman at *Paris* who made many and dangerous Wounds in his *Abdomen*, of which notwithſtanding he recovered; and the following Year threw himſelf from the Top of a Church; upon opening him, his Inteſtines were found adhering to all the Parts of the *Peritonæum*, which had before been wounded by him. The Uſe of the *Omentum* in warming the *Abdomen* is very remarkable, in the Hiſtory which *Galen* gives us of a Swordſman which he ſaw, who had his *Omentum* cut off thro' a Wound of the *Abdomen*; after which that Part became always ſo cold, that he was obliged to defend it with warm Cloths. But the reaſon why the *Omentum* is not extended lower than the Navel, is becauſe there the Force of the abdominal Muſcles is very much diminiſhed, and ſo there is leſs danger of their adhering to the *Peritonæum*, and of being injur'd by Preſſure: but even below the Navel provident Nature has not been wanting, for in that Part the cellular Membrane of the *Peritonæum* is gradually more and more diſtended with Fat.

[3] The oily Fluid contained in the Cells of the *Omentum*, is reſolved into a ſubtil Vapour by the conſtant Motion and Heat of the Parts, and become ſo volatiliz'd, as to paſs thro' its ſmall Pores and lubricate the Inteſtines. That the Oil of the *Omentum* does exhale thro' its Pores, is confirm'd by many Experiments: *Ruyſch* ſaw innumerable ſmall Orifices by a Microſcope in the *Omentum*, after

after he had waſh'd off the Oil by a long Maceration; the Oil of the *Omentum* alſo paſſing thro' theſe Pores, makes the Fingers of the Anatomiſt feel greaſy upon handling the ſame in a dead Subject. To theſe we may add, that the Injection of *Ruyſch* has made its way thro' the ſame Pores, by which the oily Vapour exhales; and the ſame alſo ſeems to be proved by the rancid Vapour which appears upon opening the *Abdomen* of live Animals, as alſo from the ſudden Decreaſe of the Fat in Animals which have been ſtuff'd or fed; which if fatigued with ſudden and violent Exerciſe, become three times leaner than they were before; as is experienced in Horſes, whoſe oily Cells, placed between the two Membranes of the *Omentum*, are diſcharg'd of their Contents; inſomuch that a real Oil has been ſeen forced out of the *Omentum* by ſudden and violent running, and retained in the Cavity of the *Abdomen*, which has been the death of many fine Horſes.

[4] By the Action of the ſeveral Muſcles of the *Abdomen*, the oblique aſcending and deſcending Muſcles, together with the Recti, Tranſverſe Muſcles and the *Diaphragm*, do all alternately preſs upon and agitate the Viſcera of the *Abdomen*.

[5] This appears from Anatomy, whereby is demonſtrated, that no Part of the Chyle is found incraſſated in the ſmall Inteſtines, from the *Pylorus* down to the *Cæcum*; at which Part it ſuddenly begins to put on a more firm Conſiſtence; and in the *Cæcum* and Cells of the *Colon* it firſt begins to turn fetid, and put on a ſolid and globular Figure.

[6] It is a common Error to imagine that the Inteſtines are a Tube as thin as Paper, diſtended with Air; but whoever has ſeen the Inteſtines of a live Animal, or in a human Body ſlipping thro' a Wound of the *Peritonæum*, will be certainly aſſured

red that they are neither ſo thin nor ſo pellucid, but thick, narrow, and having very little Cavity, unleſs they ſhould be diſtended by *Flatus* or morbid Relaxation.

[7] The periſtaltic Motion of the Inteſtines is perpetual, and continues even after Death; and when it then ceaſes, it may be eaſily renewed; as the Heart itſelf may be excited to its Motion by forcing Wind thro' the thoracic Duct. Nor am I ſenſible of any other reaſon why we can recall a Patient to Life who is in a deep *Deliquium*, without any Pulſe, but by communicating new Motion to the Chyle in the Inteſtines, whereby it is propelled by their vermicular Contraction into the thoracic Duct; which being thus drove forwards, will alſo give the Blood a Tendence to the Heart, and recall it to its priſtine Motions. But this periſtaltic Motion begins at the *Oeſophagus*, and terminates at the end of the *Ilium*; the large Inteſtines not being agitated in the ſame manner, it gradually deſcends from the *Pylorus* to the beginning of the *Cæcum*; and ſometimes aſcends circularly from the *Colon* toward the *Pylorus*, being always performed in but one Part of the Inteſtines at a time, and never continued at once thro' the whole Tract.

[8] The very tough and ſlippery Skins of Animals, and many vegetable Fruits, are ſo opened by Maceration only, that after parting with all their alimentary Juice, they are caſt out dry in the Fæces.

[9] The Quantity of diluent Liquor afforded by the Inteſtines to the Chyle, may be eſtimated from the great Extent of that Tube, from the great Number and Size of the meſenteric Arteries, which has been calculated by *Borelli*; alſo from the Experiments of *Ruyſch*, whereby the ceraceous Injection

ction paſſes thro' the excretory Ducts of the meſenteric Veſſels into the Cavity of the Inteſtines; alſo from the Appearance of the Aliment, which is found not much thicker at the end of the *Ilium*, than it was in the Stomach, even after it has parted with ſo much of its lacteal Juice; which is a manifeſt Argument that it is ſupplied with a conſiderable Quantity of new Juices, equal to what was abſorbed by the lacteal Veſſels; for if it was not equal, the Relicks of the Aliment would become indurated in the ſmall Inteſtines; but this Juice can only be transfuſed into the Cavity of the Inteſtines by the meſenteric Arteries.

10 Thus the Juices which are contained in the ſmall Veſſels of Animals and Vegetables, are poured out of their broken Tubes, and abſorbed by the lacteal Veſſels (*Vid.* §. 87. N°. 7.) for Nature now applies the ſame Force to diſſolve their Parts, as ſhe formerly did to unite them; yet the tough Skins and Membranes are not diſſolved by the digeſtive Powers of a living Animal, becauſe Nature was employed conſtantly for four or more Months together in framing them; but the digeſtive Powers act upon them but a very ſmall Space of that Time in order to diſſolve them.

11 The Particles of the Aliment are ſo far attenuated, as to be capable of paſſing the ſmall Orifices of the Lacteals, and aſcend thro' them and the thoracic Duct into the Blood, without forming Obſtructions or running into Concretions. Bodies are volatilized according to Mr. *Boyle*, either, 1. by increaſing their Surface ſo far, that their Weight cannot overcome the Reſiſtance of the Medium in which they aſcend. Thus a Wedge of Gold may be extended into ſuch an immenſe Surface, as to ſwim in Water, and very difficultly deſcend even in Air, notwithſtanding that Metal exceeds by

by its ſpecific Gravity the Weight of all other Bodies; or, 2*dly*, by applying a volatile and very moveable Subſtance to one that is fixed; ſo that the lighter Subſtance adhering to the heavier, carries it up with itſelf in a Sublimation. Thus Iron, which is ſo ponderous a Metal, is render'd ſo volatile by mixing with *Sal Ammoniacum*, as to ſublime in the Form of Flowers. Both theſe Methods are made uſe of by Nature to volatilize or attenuate the Chyle, whoſe Particles are expanded by Heat, and their Surfaces increaſed by Dilution; and the Liquor with which they are diluted being very ſubtil and moveable, elevates with itſelf the more heavy and fixed Particles of the Aliment, and ſo makes them volatile. The Change this way wrought in the Parts of the Aliment is ſo great, that an Ox or a Man that feeds only upon Vegetables, which contain an acid and fixed Salt, will thence make Blood, whoſe Salts are volatile, and naturally turn into an Alkali. The volatile Nature of Animal Subſtance is confirmed by a remarkable Argument of *Bernier*, when he relates that the Carcaſe of that vaſt Animal the Elephant turns all into Vapours in a few Days by the Heat of the Weather at *Indoſtan*, leaving nothing but a dry Skeleton. And thus alſo the human Excrements which are thrown about the Streets at *Madrid* in *Spain*, are in one Day dry'd by the Heat of the Weather into an inodorous Powder, without infecting the Air with any Putrifaction.

[11] There can by no means be made a better Separation of the more ſubtil Parts of a ſoft pulpy Subſtance in an Emulſion, than by this Method of continually pouring in freſh Supplies of new Juices in a conſiderable Quantity; but this Juice poured into the Inteſtines, is again ſtrongly expreſſed, ſeparated, poured into them afreſh, and then again

expreſſed and conveyed into the Blood: and this Emulſion is more perfectly performed by the ſoft Parts of the Aliment being admitted into the numerous Cells of the Inteſtines, in order one after another, in each of which it is compreſſed, attenuated, and opened, meeting with a Reſiſtance in every Part, except at thoſe Orifices which lead to the Lacteals; by which means is obtained a compleat Separation of all the more fluid Parts in the Chyle. But this Emulſion of the Aliment is alſo the more exact, by being performed in ſo long a Tube as the Inteſtines, through which it is many Hours in paſſing, whereby all the more fluid and nutritious Parts of the Aliment are drained off the more compleatly. In like manner a Separation is made of the more ſubtil and uſeful from the leſs ſerviceable Parts of oily and farinaceous Seeds, by pouring on a large Quantity of Water, then beating them into a milky Emulſion, then decanting and expreſſing the milky Liquor, and pouring on freſh Water, repeating the Operation as before; by which means nothing will be left but the hard, earthy, and inſoluble Parts of the Seeds.

[13] The Orifices of theſe Veſſels being ſo ſmall as to eſcape the Sight, even when armed with a Microſcope, has occaſioned many to imagine that the Paſſage of the Chyle thro' ſo ſmall Veſſels, can be explained no other way than by Suction; which is ſtill further countenanc'd by the Inteſtines taken out of a dead Subject, and ty'd at each end, not tranſmitting any of the Air or Water with which they were diſtended; which ſeems to argue, that there are no Pores in the Inteſtines capable of receiving any Liquor; but that is a Falacy ariſing from the Loſs of the periſtaltic Motion, and the Stricture of the abſorbing Orifices, which are now empty and collapſed. So thick a Fluid as Milk would

would never paſs the Lacteals, if it were to ſuffer a free Paſſage, without Reſiſtance or Preſſure, thro' the Tract of the Inteſtines; but its Paſſage is retarded, and moſt fluid Parts expreſſed, by the periſtaltic Motion, as many times as the Chyle is ſucceſſively applied to freſh lacteal Orifices, through which ſome of the more fluid Parts find a ready Admittance; for if a thin Tincture of Indigo Blue be injected into the Inteſtines of an Animal juſt kill'd, while they are yet warm and contracting, and you aſſiſt it with a gentle Preſſue, like what the Chyle ſuffers in the *Abdomen*, the Tincture will then viſibly enter the Lacteals, and tinge them of a blue Colour; which is proved by an Experiment of the Royal Society, *Phil. Tranſ. Abr. Vol* 3. *p.* 101. *ſeq.* Nor is it any Wonder that the Lacteals ſhould ſo collapſe after Death, as to render their Orifices inviſible by any means, ſince the excretory Ducts of the meſenteric Veſſels do the ſame; for Wind cannot be preſſed thro' them into the Blood, notwithſtanding they are ſo large as to emit the ceraceous Injection thro' their Orifices into the Cavity of the Inteſtines.

[14] In four Ounces of Bread eaten by a faſting or hungry Perſon, there will always remain ſome nutritious Parts, capable of being abſorbed by the Lacteals, even after it has been digeſted in the Stomach, and drained in the Inteſtines for a whole Day and Night; it is therefore advantageouſly retarded for that Purpoſe by the retrograde periſtaltic Motion, with the numerous Valves, Convolutions, and great Length of the Inteſtines, whereby one Drachm of the ſame Aliment is ſucceſſively applied to, and drained at leaſt above a hundred times by freſh Orifices of the Lacteals, before it arrives at the large Inteſtines. This Artifice of Nature's protracting the Inteſtines to a conſiderable

Length, is continued almoſt univerſally thro' all Sorts of Animals, but with a ſurpriſing difference in their particular Diſpoſitions, according to their different Nature, and the Structure of their other Parts. The Inteſtines of a Hare are ſhort, that they might not obſtruct the Swiftneſs of that Creature; but then it has a large *Cæcum*, whoſe Cavity is ſo divided by a ſpiral Valve, that it performs the Office of the longeſt Inteſtines, tho' commodiouſly wound up in ſo ſmall a Space. The voracious Dog or Wolf-fiſh has Inteſtines not above a Foot long, but then their Cavity is lined internally with a beautiful ſpiral Valve, or Reduplication of their inner Coat, which retards the Aliment from a too quick Paſſage. The Range-deer of *Lapland* has very long Inteſtines, but then they are ſmall or narrow, to facilitate the running and long faſting of that Animal.

§. 96. The *Duodenum* [1], or firſt of the ſmall Inteſtines, has this in peculiar to itſelf, that it is diſpoſed in a *ſtreight* [2] Direction, being alſo narrow, and without Inequalities or Valves, connected to the Back by a Proceſs of the *Omentum* [3], and but very looſely, if at all, to the *Meſeræum*; it is perforated near the End of its ſtreight Progreſs, for the Inſertion of the common *Duct* [4] of the Bile, and for the pancreatic Duct of *Virſungius*, which latter opens into the villous Coat by ſometimes a ſingle, but frequently a *double* [5], Navel-like Aperture, either ſeparate or joined cloſe together; therefore the Chyle paſſes quickly thro' this Inteſtine, ſliding by its Perforations with but little Alteration, and parting with but little of its lacteal

lacteal Juice; becauſe we are taught by the anatomical Diſſection of it, that there are very few Lacteals opening into it, and that the retarding Valves are much more leſs both in Size and Number than thoſe obſerved in the following *Jejunum* and *Ilium*.

[1] The Inteſtines were very early diſtinguiſhed by the Ancients into *Tenuia*, or ſmall; and *Craſſa*, or large; the *Tenuia* they again ſub-divided into the *Duodenum*, *Jejunum*, and *Ileum*. But the Moderns aſk, what neceſſity there is for impoſing diſtinct Names on the ſmall Inteſtines, when they are but one continued Tube? An Anſwer is ready, that Nature has wiſely diſpoſed that Tube differently in different Parts; and that it was a Piece of Induſtry among the Ancients to obſerve and diſtinguiſh that difference according to Nature.

[2] It is remarkable that this is the only Inteſtine, with the beginning of the *Jejunum*, that is diſpoſed in nearly a ſtrait Courſe; all the reſt being ſurpriſingly convoluted into various Turnings and Windings.

[3] The *Duodenum* is connected to the *Pancreas*, and the *Pancreas* is inveſted by the poſterior *Lamen* of the *Omentum*; by this Communication the *Duodenum* is therefore connected to the *Omentum* and Loins, and to the Liver by the common Duct of the Bile; which Connection was the more neceſſary, as it uſually is not attached to the Meſentery, the common Support of all the other Inteſtines.

[4] Which is about the Size of a Gooſe-quill, its Aperture being furniſhed with a ſort of Caruncle or Valve, which admits the Bile from the Liver into the *Duodenum*, but prevents any thing from

returning again out of that Inteſtine into the Duct, which has been ſometimes found dilated to an incredible Size by calculous Concretions.

[s] There are very few Inſtances of the pancreatic or biliary Ducts opening into the upper Part of the *Duodenum*; but in ſome of the rapacious Animals thoſe Ducts are inſerted by three diſtinct Apertures; as in Fiſh, Lions, Tygers, *&c.* but their Inſertion is ſo oblique, paſſing a conſiderable way between the Coat of the *Duodenum*, that they muſt of neceſſity be compreſſed whenever that Inteſtine is diſtended with Aliment; for the *Ductus Choledochus* paſſes firſt a little way between the external and muſcular Coat of the *Duodenum*, it then paſſes about an Inch further between its internal villous and muſcular Coat; which Mechaniſm performs the Office of a Valve, that the Bile may find a ready Paſſage out of the Duct into the Inteſtine, but that nothing might return that way back again.

§. 97. It therefore appears from hence, that three different Fluids are received and mixed with the Chyle in the lower Part of the *Duodenum*, where it opens into the *Jejunum* [1], to wit, the hepatic and cyſtic Bile, with the lymphatic Juice of the *Pancreas*. The *Jejunum* is continued from the lower Part of the *Duodenum*, from whence it ariſes nearly in a *right Angle* [2], and proceeding backwards from it, occaſions a Stoppage and Mixture of the Bile and pancreatic Juice with the Aliment.

[1] The *Duodenum* ariſes from the *Pylorus*, and terminates at its Incurvation, immediately below the Inſertion of the biliary Duct, where it begins to

to be called the *Jejunum*, becauſe it is generally found empty, and is diſtinguiſhable from the other Inteſtines by its large Number of Valves. The *Ilium* ariſes from the preceding Inteſtine, where its Valves become leſs numerous; and in this Inteſtine the Contents of the Stomach are found thicker as they are nearer to the *Colon*.

[a] When a perpendicular Cylinder changes its Courſe, ſo as to become parallel to the Horizon, it forms a right Angle, which is eaſily demonſtrated by Geometricians, and occaſions a Check to the Motion of a Fluid paſſing thro' ſuch a Cylinder; as this Structure is therefore found at the end of the *Duodenum*, the Chyle, pancreatic Juice, and Bile, wille be in ſome meaſure obſtructed, and be more intimately mixed before they paſs over the firſt Valve of the *Jejunum*. The Reſiſtance which the Contents of the *Duodenum* meet with in this Angle is ſo conſiderable, that in Animals which have been ſtarved to death, to render them more reliſhing, I have ſeen the Stomach full of Bile; which not being able to overcome the Reſiſtance of this Angle at the *Jejunum*, did yet make its way thro' the leſs reſiſting *Pylorus*. The Uſe therefore of the *Duodenum* appears to be for mixing the Aliment with the Bile and pancreatic Juice, which is promoted by being check'd and retain'd ſome time in its Progreſs by this Angle of the *Jejunum*; for it is certain that it cannot abſorb much Chyle, becauſe it has few or no Lacteals; nor can it afford any conſiderable Quantity of the inteſtinal Juice, ſince it is not connected, like the other Inteſtines, to the Meſentery.

Concerning the Nature and Action of the cyſtic and hepatic Bile.

§. 98. THE Bile diſcharged into the *Duodenum* is of two Kinds, either cyſtic or hepatic. The cyſtic Bile or that of the Gall-bladder, is thicker, darker coloured, and *more bitter* [1] than the Hepatic, which flows immediately from the Liver; the Cyſtic does *not conſtantly* [2] run into the *Duodenum*, but only in a large Stream at ſuch times as it is forced out by a *Contraction of the muſcular Coat* [3] of its including Bladder, or by ſome external *Compreſſure* [4]. The *hepatic Bile* [5], which flows in a *continued Stream* [6] from the Liver into the *Duodenum*, barely from the expulſive Force of the vibrating Arteries, and of Reſpiration, is much thinner, *leſs acrimonious* [7], and more pellucid than the preceding; with theſe the pancreatic Juice alſo flows almoſt continually into the ſame Inteſtine. Theſe three Juices being mixed together with the *Saliva* and *Mucus* of the Mouth, *Oeſophagus*, Stomach and Inteſtines, form a viſcid and *frothy Liquor* [8] in the Cavity of the *Duodenum*, which is oftentimes preſſed back again into the empty Stomach.

[1] This is by much the moſt bitter Juice of any which circulates in the Maſs of Blood, but it has a ſort of balſamic Taſte joined with its Bitterneſs, hardly imitable by any other Subſtance, except the Ear-

Ear-wax, and the Bitterneſs of *Elecampane.* This Bile is more acrimonious and bitter, as the Animal is more voracious, and better in Health; as we find in the Sea-Wolf, and in the Land Animal of that Name; but when the Body is diſordered the Bile is then made leſs bitter.

[2] Hence it is, that in Animals which have faſted a long time, the Gall-bladder is ſo full and diſtended with Bile, as to be almoſt ready to burſt. And I myſelf have ſometimes found the Gall-bladder ſurpriſingly diſtended with a very bitter, yellow, and viſcid Bile in Swine, which have deſignedly been made to faſt for ſeveral Days; for as the Cyſtic Duct ariſes perpendicularly upward out of the Gall-bladder, the Bile cannot aſcend out of it, unleſs it be preſs'd by a conſiderable Force.

[3] By the Contraction of the Fibres of the ſecond Coat in the Gall-bladder, which according to *Ruyſch* are muſcular, and variouſly interwove in different Directions, ſome of them running according to the Length of the Bladder, and others traverſing the former. Theſe Fibres being contracted by the Irritation of the Bile when become too acrimonious and abundant, occaſions the Gall-bladder to diſcharge its Contents.

[4] When the Stomach is diſtended, it preſſes againſt the Gall-bladder, the Neck of which is at that time inclined; alſo the Action of the *Diaphragm* aſſiſts the Liver and Gall-bladder to diſcharge their Bile, ſo that it is wiſely contrived for the Bile to be preſſed moſt plentifully into the Inteſtines when it is moſt wanted; that is, during the Digeſtion of the Aliment in the Stomach; tho' it may alſo be forced out by other external Cauſes, and barely by compreſſing the right *Hypochondrium*, as appears from the bilious *Ructus* which follows. The Bile is alſo frequently diſcharged ſo plentifully by

by Vomits, as to regurgitate into the Stomach; and Paſſengers who are unaccumſtomed to the Toſſings and Air of the Sea, are commonly ſeiz'd with a convulſive Motion of the *Diaphragm* and Vomiting; in which they diſcharge the Bile mix'd with the Juice of the Stomach and *Pancreas*, called by the Sailors Water-gall.

[5] There have been ſome Anatomiſts who have imagined, that the Bile does not come from the Liver; but that the Bile, which they think is ſeparated in the Gall-bladder, is conveyed to the Liver, and there tranſmitted into the Blood; but they ſeem to have not ſufficiently conſidered the Nature of this *Viſcus*; for the Liver appears, from its Number of Blood-veſſels, to be intended for no other Uſe, than a glandular Secretion of the Bile, the Gall-bladder itſelf being too ſmall to afford ſo large a Quantity of that Juice as is daily diſcharged into the Inteſtines. But the Bile is properly of two Kinds; that which comes immediately from the Liver, has a ready Paſſage into the *Duodenum*; but the Paſſage of that from the Gall-bladder is more difficult, on account of the perpendicular Aſcent, and acute Angle of the cyſtic Duct; upon paſſing a Ligature about the hepatic Duct, a Tumour ariſes between the Liver and Ligature; there is alſo a conſtant Diſcharge of Bile from the Liver, when the Gall-bladder has been broke or cut out; to which we might add other weighty Reaſons, that perſuade us the Bile flows from the Liver into the *Duodenum*. If any one objects, that only the more bitter Juice of the Gall-bladder ought to be called Bile, he is at liberty to call it *Lympha hepatica*, or any other Name; and tho' it is true that the Bile may in ſome Caſes regurgitate from the *Duodenum* thro' the common Duct to the Liver, it is yet to be doubted whether it paſſed thro' the

Ductus

Ductus cyſticus into the Gall-bladder; tho' it does not ſeem poſſible, if we conſider the Reſiſtance caus'd by the acute Angle made between the cyſtic and hepatic Duct. Perhaps ſomebody may anſwer with *Bohnius*, that the hepatic Bile regurgitates into the Gall-bladder when its common Duct is obſtructed; but I think ſuch Obſtruction will alſo at the ſame time much prevent the Bile from paſſing out of the common Duct into that of the Gall-bladder; for the hepatic Duct being diſtended, will contract the Diameter of the Cyſtic, which, together with the Angle formed by them, will intercept the Bile from the *Ductus cyſticus*.

[6] *Revenhorſt* opened the *Abdomen* of a Dog, divided the *Duodenum*, and faſtned the *Ductus Choledocus* to a Quill, which he inſerted into a Receiver, where the Bile, continually poured in, but very dilute, and not much bitter; as it is alſo found in the Liver of a living Animal, or of one that has been lately killed, being very different from the Bile in the Gall-bladder, eſpecially in Swine, whoſe Liver and three biliary Ducts, have a great Affinity to thoſe of the human Body. The Mildneſs of the hepatic Bile is very obſervable in eating the Livers of Fiſh, Fowl, and Quadrupeds, in all which that *Viſcus* is very pleaſant and palatable, whereas the leaſt Drop of the cyſtic Bile communicates a very ſtrong Bitterneſs thereto; the Quantity of hepatic Bile which is continually diſcharged, much exceeds that of the Gall-bladder; which will appear from conſidering, that the Liver is a much larger Gland than any other in the whole Body, a *Viſcus* conſiſting of more Veſſels, without Fat or Muſcles, and of ſo lax a Texture, that Water readily paſſes thro' the *Vena portæ* into the *Cava*; alſo from conſidering the great Force with which the Blood is impelled into the Liver by the

the two meſenteric Arteries, and the cœliac Artery ariſing from the *Aorta*; but that it is alſo ſtill more confirmed by Experiment; for *Revenhorſt* collected it at the Rate of three Drams, or half an Ounce in two Hours, or ſix Ounces in four and twenty Hours, in a Dog; and therefore the Quantity of Bile ſeparated in the human Body, where the Liver is ſo much larger than that of the Dog, muſt greatly exceed the forementioned Quantity.

[7] It is ſometimes ſweetiſh, but always watery, and almoſt pellucid, being tinged but of a very pale Yellow, it is taken to be more bitter by Authors than it really is, becauſe they taſte the Mixture of it which paſſes thro' the common Duct joined with the Cyſtic-Bile; but the chief of its Bitterneſs proceeds from that of the Gall-bladder.

[8] This Liquor being retained in the Cavity of the *Duodenum*, till it is almoſt beginning to putrify, by ſtagnating in ſo warm a Part, is ſometimes by the periſtaltic Motion, or an external Preſſure, protruded into the Capacity of the Stomach, cauſing a Bitterneſs in the Mouth and *Fauces*, and is vomited up under the Name of Bile.

§. 99. The cyſtic Bile eſpecially corrects *Acidities* [1], prevents the Chyle from turning Sowr, and impregnates it with its own Qualities; it is of a *Saponaceous* [2] and ſcouring Nature, diſpoſing Oil to mix with Water; it diſſolves and attenuates reſinous, gummy, and other tenacious Subſtances, reducing them into an uniform Mixture; it is neither *alcaline* [3] nor *acid* [4], but *conſiſts* [5] of ſaline, oily, and ſpirituous Parts, diluted with Water, not *combuſtible* [6] till it has been firſt dried, being the moſt acrimonious Humour of any *Circulating* [7]

ting [7] in the whole Body, eaſily putrifying; and when putrified, very penetrating and volatile, tranſuding thro' all Parts of the Body. The Uſe of the Bile therefore, upon being mixed with the Chyle and Fæces, is to attenuate and diſſolve the oily Parts, intimately *mix them* [8] with the watery, to *cleanſe* [9] off Viſcidities, and *ſtimulate* [10] the muſcular Fibres of the Inteſtines to their periſtaltic Motion; it alſo obtunds and corrects the ſaline and acrimonious Parts of the Chyle, *diſſolves* [11] ſuch as were coagulated, and opens the lacteal *Paſſages* [12] for the Reception of the Chyle; it excites the *Appetite* [13], and acts as a *Ferment* [14], in aſſimilating the crude or prepared Aliment. It is ſometimes diſcharged in healthy Perſons, by inſerting its Duct at the bottom of the Stomach, as it uſually does in the *Oſtrich* [15], which is a moſt voracious Bird. The Effects of the Bile here deſcribed are poſſeſſed in a much ſtronger Degree by that of the *Gall-bladder* [16], than that of the *Liver* [17]. But what further relates to this Subject, will be conſidered when we deſcribe the Liver.

[1] There is no Subſtance in the human Body that putrifies ſooner, or to a greater degree, than the Bile; nor was that Juice ever found to turn acid; but upon ſtanding ſome time in a warm place, it preſently turns rank and putrid of its own accord, and ſmells intolerably; but after ſtanding a conſiderable time, it contracts the Smell of Ambergreaſe. In ardent Fevers the Bile is extremely acrimonious, and gives the Fæces a cadaverous Smell. From this Juice it is that the aceſſent Aliments,

ments, upon which only many Animals feed, do not put off their acid Nature in the Stomach, but in the *Duodenum*, where they become ſaline or ſweet; and hence it is, that in young Infants and gouty People, who live only upon Milk, the Fæces caſt out of the Body are not acid, but bilious and yellow; and if the Acid ſhou'd be ſometimes ſo ſtrong as to overcome the alcaleſent Property of the Bile, the Bile by that means is rendered inactive, and incapable of performing its Office, of attenuating and mixing the Parts of the Chyle in the Inteſtines. In the Stomachs of Calves there are always found acid Contents, but not the leaſt of any Acid in the Inteſtines; it alſo appears from Experiments, that the Bile being mixed with Acids, is coagulated, precipitated, and variouſly changed in its Nature.

[a] It appears to be ſaponaceous, by rendring oily Subſtances miſcible with Water; ſo that the firſt may be waſhed off from thoſe Parts to which they have adhered by mere Water; and ſuch is the Nature of Soap, a Body compoſed of Oil and alcaline Salt; by whoſe Action Oils terebinthinate Balſams, Gum-Reſins, and other reſinous Subſtances, which repel Water, are ſo reduced, as to be intimately miſcible with that Fluid. In the ſame manner does the Gall of Oxen waſh out Spots of Greaſe from Woollen Cloths; and thus alſo new Wool, which being covered with the greaſy Sweat of the Sheep, and rank Oil of the Comber, refuſes to take the Colour of any Dye, is uſually prepared by ſcouring in a Lye of Urine, but ſucceeds much better in one of Gall; by which means it becomes bibulous, and ſuſceptible of the Colour. In like manner alſo raw Silk, as it comes from the Worm, varniſhed over with a ceraceous Subſtance, wou'd never take any Colour, if the gummy Subſtance was not to be

firſt

firſt ſcoured off by a *Lixivium* made of Water and Gall. Paints, with the hard Gums of *Juniper* and *Lac*, and other glutinous Bodies, become eaſily diluted with Water, ſo as to run freely thro' the Pencil, when they have been firſt well ground with Gall upon a Marble: Therefore a Defect in the Quantity and Strength of the Bile, will leave the Inteſtines plaiſtered with too much of their gluey *Mucus*; but if it be too abundant or acrimonious, as it ſometimes is in Fevers, the Inteſtines are thereby denudated or excoriated.

[3] It has been aſſerted by *Sylvius* after *Helmont*, and by moſt of the *Dutch* Phyſicians after *Sylvius*, that the Nature of the Bile comes neareſt to that of a volatile alcaline Salt joined with a volatile Oil; and that the *Chymus* of the Stomach being mixed with its acid Ferment in that Organ, and afterwards impregnated with the acid Juice of the *Pancreas*, does then paſs into a Fermentation with the Bile; upon which follows a Precipitation of the more earthy and feculent Parts, which deſcend thro' the Inteſtines, while the more fluid Part of the *Chymus*, being converted into a vital alcaline Nature, is taken in by the Lacteals. But we can ſee nothing in this whole Hypotheſis agreeable to Nature; the healthy Bile of the human Body is never alcaline, nor ſo much as ſmells urinous by the Heat of a Bath; and if it has any Odour, it is aromatic and grateful; nor does it effervеſce with Acids, except only Oil of Vitriol, which will even cauſe an Ebullition with Water; but the Bile is render'd turbid and coagulated ſeveral ways, according to the different Diſpoſition of Acids. And if it were to be allowed true that the Bile effervеſces with Alluin, which was objected to me by a profound Chemiſt, even that Obſervation is of no Force againſt us; becauſe Allum is not really an acid

acid Salt; nor does it cauſe an Ebullition with Acids, nor is the Origin of Bile from Fire, which is the common Riſe of all alcaline Salts; nor does it proceed from an alcaline Liquor, ſince the Blood from which it was ſeparated is far from a lixivious nature; nor has the Bile an alcaline Acrimony, for if it had, it would corrode and deſtroy the ſmall Veſſels where it paſſes; nor will it tinge that of Violets of a green Colour, as Alcalines do. We do not indeed deny that the Bile will turn into a very acrimonious Alcali barely by Putrifaction; but no rational Perſon will eſteem a ſound and healthy Subſtance to be of the ſame Nature as it appears after Putrifaction and Corruption. This is certain, that the Bile does not afford any volatile Salt by the Heat of boiling Water, much leſs will it afford any by a Heat equal to that of the human Body; for by this Rule we ought to attribute the inebriating Faculty of Ale and Spirit of Wine to Barley, becauſe they are prepared from that Grain, by its undergoing various Treatments and Alterations. And if you ſhould ſay with ſome, that the Bile contains a latent Alcali, even that would not be true; for we are never ſenſible of an Alcali in any Body, but it muſt ariſe from Fire or Putrifaction.

4 The *Hippocratic* Sect of Phyſicians formerly maintained, even in this Univerſity, that the Bile was acid, in Oppoſition to the preceding Hypotheſis; but thoſe ſeem to be ſtill farther from the Truth, becauſe the Bile can by no Artifice or Change whatever be render'd acid. If ſome object, that the green Stools of Infants ſmell ſowre from the Mixture of Bile, they will even contradict Experience; for they afford an acid Smell, thro' a Defect in the Strength and Quantity of the Bile, or from the Aliments being turned acid by their

their too long Stay in the Stomach before their Mixture with the Bile; for this Obſervation no more demonſtrates the Bile to be acid, than Oil of Tartar *per deliquium* can be proved acid from its compoſing *Tartarus vitriolatus* with Oil of Vitriol, a Salt which is more acid than alcaline.

[5] Such is the Compoſition of the Bile from a chemical Analyſis. The Bile of an Ox's Gall-bladder being firſt applied to a gentle Heat, exhales a watery Lymph, almoſt without Smell or Taſte, which equals three Parts out of four of the whole; the Reſiduum in the bottom of the Veſſel being a glutinous, ſhining, and bitter Subſtance, of a yellowiſh green Colour, which neither effervesces with Acids nor Alcalies, and may be kept a long time without putrifying; this Subſtance being diſtilled in a Retort with a Heat of three hundred Degrees, affords much Oil; and by increaſing the Heat, a ſmaller Quantity of a truly volatile Salt, leaving much Earth in the bottom of the Retort; from 12 Ounces of Bile there comes off 9 of Water, 2 Ounces and a half of Oil, and a Dram or two of Salt. Nearly the ſame Proportion of fixed Salt and Oil is obſerved in the making of common Soap, about one Ounce of Lixivium being added to three of Oil; which Ounce of Lixivium contains about five Scruples of fixed Salt; ſo that the Proportion of the Oil will be to the Salt as 1920 to 100. But in the human Bile the Proportion of the Water to the Oil is as 10 to 2; to the Salt as 72 to 1, or ſomething leſs; it was neceſſary there ſhould be more Water than other Principles in the Bile, that it might form a fluid Soap, capable of being ſpeedily mixed and diluted with watery Liquors; and this is the true Compoſition of recent Bile: but when the Bile has been putrified, it affords a larger Quantity of a ſtronger volatile Salt; which alſo

holds true of all the other Parts of the human Body after they have been putrified.

[6] Recent Bile extinguiſhes a red hot Coal; but after its aqueous Part has been evaporated, it takes Flame and burns; the Bile does not therefore act in the human Body as Sulphur, but as Soap, or an Oil diſſolved in Water; but as for the oily and bitter Subſtance which is ſometimes regurgitated from weak Stomachs, that is indeed inflammable, but it ſwims upon Water, and is very different from Bile, being the oily Part of the Aliment putrified in the Stomach.

[7] There is no Humour in the Body except the Ear-wax, and the Urine, which has an Acrimony of the ſame nature with the Bile; all the other animal Juices are much leſs acrimonious; and thoſe two are real Excrements, depoſited in their proper Receptacles, and never returned again into the Blood.

[8] The Bile is intimately mix'd with the Aliment, after it has been firſt diluted with the pancreatic Juice; which Mixture is promoted by their being retained and agitated in the warm *Duodenum*, in which Inteſtine the alimentary Maſs appeas an uniform and frothy Fluid, the Bile not being capable of exerting its Force upon the Aliment without an intimate Mixture. It diſſolves fat Subſtances, and ſuch things as curdle with Acids; nor could oily Subſtances be capable of paſſing the Lacteals, if they were not firſt attenuated by the Bile.

[9] Some Men will raſhly ſwallow reſinous, oily, gluey, and terebinthinate Subſtances; which ſometimes adhere to the *Duodenum*, and cauſe an incurable Iliac Paſſion; but there are very few, if any, Obſervations of that Diſorder from this Cauſe, becauſe the Bile ſcowrs off thoſe glutinous Subſtances, and renders them miſcible with Water; it attenuates

nuates ſuch Parts as were concreted, and renders them ſo fluid as to paſs the Lacteals. The Efficacy of the Bile in this reſpect is well known to Painters, who uſe the Gall of an Ox diluted with Water, to attenuate their grumous or concreted Paints. At the ſame time that the Bile prevents the oily and viſcid Parts from ſtagnating, and adhering to the Sides of the Inteſtines, it alſo hinders them from turning rank and cauſtic; which they frequently would do to ſuch a degree in the Stomach and Inteſtines, if it was not for the Bile, as to endanger their Excoriation. It is by the Bile only that we are enabled to digeſt Butter, Oil, and fat Meat; of which Subſtances we may eat more plentifully, as we have a larger Stock of Bile; but a Perſon that has little or weak Bile, would be greatly injured by thoſe Subſtances; and ſuch Subſtances are ſo far from generating Bile, that they obtund and deſtroy it.

[10] The Bile being mixed with the Fæces of the Inteſtines, ſtimulates them to their periſtaltic Motion, by which they are caſt out of the Body; and if it regurgitates into the Stomach, it there excites Hunger; if it is obtunded or overpowered with Acids, it ceaſes to perform its Office; whereupon Obſtructions enſue, the Inteſtines are clogg'd up, and the Perſon is coſtive, *&c.* If it abound in Strength and Quantity, or becomes putrid, it occaſions a Diarrhæa, or purging, like that produced by Myrrh and Aloes, which are pretty much of the ſame Nature with the Bile.

[11] The Milk which is taken into the Stomach of a Calf, quickly curdles, as well from the Ferment of the preceding Milk in the Stomach, as from the natural Diſpoſition of the Milk itſelf to that State; the ſerous Part of it is then drained off, and the remainder becomes a thick Cheeſe, which is ſtill fur-

ther drained in its Paſſage thro' the ſecond, third, and fourth Stomach of the ſame Creature, till at length nothing but a tough and Cheeſe-like Maſs is conveyed to the *Duodenum*, which is of ſuch a Nature, that it will almoſt turn into a horny Conſiſtence, as we ſee in the outſide of Cheeſes; but it is no ſooner arrived in the *Duodenum*, but the whole tenacious Maſs is fuſed by the Bile, and is diſcharged in a fluid Excrement by the *Anus*. An eminent Gentleman liv'd a long time upon nothing but Milk, in order to be cured of the Gout; ſometime afterwards he was troubled with an Oppreſſion at his Stomach, almoſt to death; after which he vomited large round Lumps of a cheeſy Subſtance. I have alſo obſerved the like Diſorder to ariſe from a Defect of the Bile, and have ordered in that Caſe a mixture of Bile, with *Venice* Soap, which has quickly removed the hard Coagulations. We generally find that thoſe gouty People who have a weak Bile are very coſtive, which may be remedied by Myrrh and Aloes, or other Subſtitutes for the Bile.

[12] By attenuating tenacious Subſtances, and exciting the periſtaltic Motion, it deterges the Sides of the Inteſtines, and ſets the Mouths of the Lacteals at open liberty.

[13] Nothing excites the Appetite more than Bitters; Myrrh, Aloes, Wormwood, Elecampane, *&c.* which ſupply the Weakneſs and Defect of the Bile. The Bile even ſeems to be one of the principal Cauſes of Hunger in a healthy Perſon. We find that when the Stomach is full we have no Senſation of Hunger, though it were filled only with Water; but as ſoon as it is empty, if we are in health, we grow hungry again; becauſe when the Stomach is empty it is flaccid, and does not reſiſt the Paſſage of the Bile into its Cavity; which by irritating its nervous *Papillæ*, excites the uneaſy Senſation

Senſation of Hunger; which is confirmed by Inſtances of gluttonous Men and voracious Animals, in which the *Ductus choledocus* has been found to open into the Capacity of the Stomach.

[14] It cannot indeed be term'd a Ferment ſtrictly, unleſs by that Name we intend a Body capable of diſpoſing other Subſtances with which it is mix'd, to turn into its own nature; for in that reſpect the Bile may be ſo call'd; which is alſo confirm'd from its being a Juice the moſt animal or elaborated of any in the Body, it being ſeparated not from the Arteries immediately, but from the Blood which has paſſed thro' the Arteries, and undergone more Actions than any other Part of the Blood throughout the Animal; for having paſſed the meſenteric Arteries and Veins, with thoſe of the Stomach, Spleen, and *Omentum*, it returns by particular Veins towards the Liver, and is then diſtributed thro' that Organ by a new kind of Arteries, the *Vena Portæ*; and then paſſes thro' the reductory Veins of the Liver, after having depoſited its Bile in its proper ſecretory Cells and excretory Ducts; the Bile therefore is not an excrementitious Fluid, but a principal Inſtrument in Digeſtion; for it no ſooner diminiſhes in Strength and Quantity, but it occaſions ſome chronical Diſeaſe, becauſe the Chyle is not rightly prepared; whence Dropſy, Cachexy, *Leucophlegmatia*, *&c.* for a Defect in the Digeſtion of the firſt Paſſages cannot be repaired in the reſt.

[15] *Duverney* has demonſtrated the biliary Duct opening into the Stomach of the Oſtrich, which is a gluttonous hungry Bird.

[16] Which is all, or the greateſt part, formed of the hepatic Bile; which cannot paſs into the Gall-bladder, but when it meets with more Reſiſtance at the *Duodenum* than it does at the opening of the cyſtic Duct; but the hepatic Bile, when arriv'd in

the Gall-bladder, is rendered more acrimonious, bitter, thick, and higher colour'd, by ſtagnating in ſo warm and cloſe a Cell, and returning many of its aqueous Parts again into the Blood by the ſmall abſorbing Veins.

[17] The Quantity of which is much larger than that of the cyſtic Bile; ſo that diluting a few Drops of the latter, it forms a penetrating Lixivium, to mix with the Aliment.

Concerning the Nature and Action of the pancreatic Juice.

§. 100. THE *Pancreas* [1] is a large *conglomerate* [2] Gland, ſituated under the bottom, a little behind, and on the right Side of the Stomach; 'tis inveſted by the poſterior *Lamella* [3] of the *Omentum*, and lies incumbent on the *Duodenum:* it is *pendulous* [4], and continually ſeparates a ſalival Humour, by its glandular Structure, from the Blood of the cæliac Arteries, which diſtilling from their infinite Number of ſmall Branches, is conveyed at laſt in one common *Duct* [5], diſcharging the ſame in the *Duodenum* (§. 96.)

[1] This Gland is call'd *Pancreas* by the Ancients, as being all Fleſh, *i. e.* entirely eatable, without any Bones or Tendons; or elſe from its being redder than the generality of the other Glands in the human Body. It might be very properly called the largeſt conglomerate ſalival Gland of the *Abdomen*, for it agrees exactly in its Structure, Figure, Veſſels,

Veſſels, excretory Duct, and in the Nature of its Lymph, with thoſe of the ſalival Glands of *Wharton*, ſeated in the Head; the Length of this Gland is about ſix Inches, its Breadth two Inches, and its Weight about four Ounces.

[2] It is compoſed of ſeveral ſmaller Cluſters of Glands, each of which are ſub-diviſible into ſtill ſmaller Bunches, from whence ariſe ſmall Emiſſaries, which opening into each other, at laſt terminate in one Duct; by which Duct the pancreatic Juice is diſcharg'd more plentifully, as that Gland is compreſſed between the *Diaphragm* and the Stomach diſtended with Aliment.

[3] In the human Body; for in the ſmalleſt Animals it is loweſt, and in Fiſh it almoſt fills the whole of the *Abdomen*; its Situation in the human Body is well figur'd by *Veſalius*, after him *Aſellius* found a Cluſter of Glands near the *Receptaculum Chyli* in Brutes, which he denominated *Pancreas*, but very improperly, ſince the Pancreas of the human Body does not come near the Meſentery; hence it is that the Cluſter of Glands in the Meſentery has been called by Anatomiſts the *Pancreas Aſellii*, to diſtinguiſh it from the true *Pancreas* of *Virſungius*, which is wrapt up in the poſterior *Lamen* of the *Omentum*.

[4] The Situation of the *Pancreas* is juſtly exhibited by *Veſalius*; and therefore *Euſtachius*, who compoſed his Tables to correct the Errors of *Veſalius*, has neglected the Situation of the *Pancreas*, and only given us a better Idea of its Figure, reſembling that of a Horſe-ſhoe; but it is connected to the *Colon* and bottom of the Stomach, and is therefore preſſed up and down at every Reſpiration.

[5] This Duct may be injected, ſo as to fill its remoteſt Branches, after it has been firſt cleanſed by injecting Water. This Duct paſſes between the

cellular Coat of the *Duodenum*, then perforates its muſcular Coat, and opens into its Cavity; this Obliquity of its Inſertion prevents any thing from returning to the *Pancreas* out of the Inteſtine; which has been a Caſe ſometimes obſerved. *Virſungius*, the Diſcoverer of this Duct was enviouſly aſſaſſinated in the Evening of the ſame Day when he publickly demonſtrated this beautiful Diſcovery; ſo that he cou'd not proſecute the ſame any further; but the Subject was afterwards taken up by *Franciſcus Sylvius*.

§. 101. The pancreatic Juice is limpid, and almoſt *inſipid*[1], or a little ſaltiſh, conſtantly ſeparated and diſcharged in *great plenty*[2] by the Motion, Preſſure, and Warmth of the circulating Blood and Parts near the *Heart*[3], eſpecially by the incumbent Stomach, when diſtended with Food. It is neither *acid*[4] nor *alcaline*[5], but nearly reſembles the *Saliva*[6], as well with reſpect to its Origin, or the Veſſels and Glands by which it is ſeparated, as in its ſenſible Qualities. When the pancreatic Juice mixes with the Bile in the Inteſtines of a living Animal, it does not appear to make any Fermentation or *inteſtine Motion*[7], but joins ſmoothly and evenly with it: Hence it ſerves to mix with and *dilute*[8] the thick Parts of the Chyle, *Mucus*, Bile, and Fæces, to make an intimate and uniform Mixture of them all, and to render the Chyle fitter to paſs the *Lacteals*[9], and mix with the Blood; to obtund or weaken the acrimonious Parts of the Chyle, and thoſe of the *Bile*[10]; to abate the Viſcidity and Bitterneſs of the laſt, alter its Colour,

and

and unite it more intimately to the Chyle: It may likewiſe ſerve both as a Vehicle and a Menſtruum, to alter or change the Taſte, Smell, and other Qualities of the various Aliments into one uniform *Nature* [11]; and to be frequently returned into the Blood, and ſeparated in the *Pancreas* again, *many times* [12] under the ſame Form and for the ſame Uſes.

[1] *Brunner* and *Swalve* have obſerv'd the pancreatic Juice to be almoſt inſipid, in oppoſition to the other Phyſicians of that Day, and particularly *Sylvius*; who, to favour his Hypotheſis, ſuppoſed it to be acid; but the Taſte of this Gland is ſo mild and ſweet, that the *Italians* prefer that with the *Thymus* to any other Part in the Calf, and call it *Bocca ſaporita*, or *the ſavoury Bit*. And if the pancreatic Juice ever taſtes ſaltiſh in the human Body, it is from the large Quantity of common Salt taken in with our Food, being often equal to half an Ounce in a Day, and is never changed into the Nature of Animal Salts by the Actions of the Body; for common Salt is extracted out of Urine, after ſix Years ſtanding, as perfectly endued with all the Properties of Sea-ſalt, as when it firſt enter'd the Body.

[2] It is ſo plentifully diſcharged into the *Duodenum*, that *de Graaf* and *Nuck* have gather'd it in a Dog at the rate of from two or three Drams to an Ounce in an Hour, being therefore ſeparated at the rate of one, two, or three Ounces in four and twenty Hours in a Dog that weighed not above ten Pounds; notwithſtanding the Secretion muſt be all that time greatly retarded by removing the compreſſing Force of the abdominal Muſcles, by opening that Cavity, and from a Contraction of the Veſſels

ſels by the Cold, and a Diſſipation of the mollifying Vapours which lubricate the *Viſcera* of the *Abdomen*, together with the Diſturbance of the whole Animal Oeconomy thro' the Tortures of the Animal. Therefore if the Weight of the human Body be compared to that of a Dog, and if the *Pancreas* be alſo compared with the other ſalival Glands, being larger than all of them put together, (yet they ſeparate twelve Ounces of *Saliva* in four and twenty Hours;) if we alſo conſider the conſtant Agitation of the *Pancreas* from the incumbent *Diaphragm* and Reſiſtance of the Stomach, together with the Preſſure of the abdominal Muſcles, while the ſalival Glands, which lie immediately under the Skin, are neither ſo conſtantly nor ſtrongly preſſed by the weaker Muſcles, of Deglutition and Maſtication; to theſe we may add, the Warmth of the Cavity of the *Abdomen*, the large Diameter of its excretory Duct, with the Force of the adjacent Heart and pancreatic Arteries: from a Conſideration of all theſe, it will appear that a larger Quantity of Fluid is ſeparated by the *Pancreas*, than all the other ſalival Glands; and that the Weight of the pancreatic Juice will not be much leſs than three Pound, ſeparated in the Space of four and twenty Hours; but in Fiſh and Inſects the Proportion of the pancreatic Juice to the Aliment is ſtill much larger, ſince this Gland is found bigger than the Liver in many of the former.

[3] From which it is ſeparated only by the *Diaphragm* and *Pericardium*; to which we may alſo add the Vibrations of the *Aorta* behind the *Pancreas*, with the adjacent cœliac, meſenteric, and ſplenic Arteries.

[4] It may ſeem ſurpriſing that ſo ingenious a Chemiſt as *Sylvius*, and many other Anatomiſts, ſhould have ſo boldly aſſerted the falſe Principle of the pan-

pancreatic Juice being acid. They gave more way to a prejudiced Notion and Hypotheſis than to Truth and ocular Demonſtration. The chemical Definition and diſtinguiſhing Marks of an Acid was then extant, and perfectly known to *Sylvius*; but among the many Properties of an Acid they cou'd not ſhew one in the pancreatic Juice; for firſt, it is not acid in a healthy Body, but by Mixture with the half digeſted Aliment, or ſome morbid Indiſpoſition, it may have ſometimes appeared to contain ſome Particles of an Acid; nor cou'd *de Graaf* ſo far relinquiſh the Truth, even under the Eye of his Preceptor *Sylvius*, but that he confeſſed the pancreatic Juice was often ſaline, ſometimes inſipid, very often ſaltiſh, and a little acid, and ſometimes only appearing entirely acid; but the Experiment which he made in a Sailor, that he opened while warm, and perceived an acid Taſte in the pancreatic Juice, ſeems to have been performed without ſufficient Accuracy, for that ſome Part of the imperfectly digeſted Chyle was mixed therewith. But the Taſte of this Juice is always ſaltiſh in the human Body; and in brute Animals, which do not uſe common Salt, it is always inſipid; which is agreeable with *Brunnerus*, and Nature herſelf: It is not however to be denied, but that the pancreatic Juice may be ſometimes acid in thoſe Diſorders which proceed from a Redundancy of acid Parts in the Blood, thro' an Indigeſtion of the Aliment; but the pancreatic Juice was never found by Expement to ferment with any alcaline Salt; for it is ſeparated from the Blood, which immediately before was alcaleſcent in the cœliac Artery, even according to the Confeſſion of *Sylvius*, who, together with *Helmont*, acknowledges the Blood to be of an oily, volatile, and alcaleſcent Nature; but for an Acid to ariſe from an Alcali, is a Change that was never yet

yet heard of in Chemiſtry, nor ever ſeen in any Experiment whatever; it therefore ſeems incredible that ſuch a great Alteration ſhou'd be made in that Fluid in ſo ſmall a time in its Paſſage thro' ſuch ſmall Veſſels as thoſe of the *Pancreas*. Some will perhaps anſwer, that the pancreatic Juice is ſecerned from the nervous Fluid, and that according to *Sylvius*, that Fluid is of a ſubacid Nature; but we ſee no reaſon why the nervous Fluid, whoſe Subtility eſcapes our Examination, ſhou'd be rather eſteemed an Acid than any other Fluid in the Body; nor does it ſeem probable that this ſubtle Fluid can be ſeparated in a ſufficient Quantity to ſupply ſo large a Diſcharge as that of the pancreatic Juice; and laſtly, there will be the ſame Difficulty to conceive how the nervous Fluid, which is alſo ſeparated from the alcaleſcent Blood, ſhou'd poſſeſs any thing of an acid Quality. The pancreatic Juice does not tinge that of Violets of a red Colour, nor curdle Milk, *&c.* If the whole *Pancreas*, together with its Juice and Duct, be taken out and boiled in Milk, it will upon keeping not turn ſowre, but putrid. *Sylvius* indeed aſſerts, that there is a latent Acid in the pancreatic Juice, but does not prove it; for ſuch an Acid, as is not of a ſufficient Strength to diſcover itſelf by Appearances, cannot be the Cauſe of ſo ſtrong an Effervеſcence as is aſſigned to it by *Sylvius*; nor does there appear any other Reaſon why *Sylvius* ſhou'd aſſign the pancreatic Juice to be of an acid Nature, than to render it conformable to his Syſtem, which required the Suppoſition of an Acid to cauſe a Fermentation with the alcaleſcent Bile.

[5] One might with more reaſon affirm the pancreatic Juice to be alcaline, agreeable with the Antagoniſts of *Sylvius*; but even that wou'd not be ſtrictly true; for which conſult (§. 99. N. 3.)

[6] The

'The pancreatic Juice is like the *Saliva* in all Appearances, as well as agreeing in the Structure of its ſmall ſecretory Glands, which are aſſembled into one conglomerate and larger Gland, diſcharging their Contents by their proper Ducts into one common larger and excretory Duct. It has been alſo frequently obſerved, that when *Mercury* excites a Salivation in the Mouth, at the ſame time there is often felt Pains in the *Abdomen* about the *Pancreas*, and a Diarrhæa follows in the room of a Salivation; the only difference between the *Pancreas* and ſalival Glands ſeems to be, in that the firſt is ſubject to the ſmaller and alternate Motions of Reſpiration, and is therefore more ſtrongly and conſtantly ſollicited to its Office than the ſalival Glands.

'The whole Doctrine of the Animal Oeconomy, Diſeaſes, and Practice of Phyſic, embraced by *Sylvius* and his Followers, were founded upon this ſingle Hypotheſis, an Efferveſcence of the alcaline Bile with the acid Juice of the *Pancreas*. This Syſtem was quickly oppoſed in a ridiculing Stile by *Carolus Drelincurtius*, a Collegue of *Sylvius*, and ſtrict *Hippocratic* or Obſervator, in oppoſition to Hypotheſis, who conceal'd himſelf by the fictitious Name of *Ludovicus le Vaſſeur*, in a Libel *de Triumviratu Humorum*; in which he banters and ſharply runs down this Efferveſcence: at the ſame time the Hypotheſis was oppoſed by *Deuſingius* in a different Method, rather by Facts and Experiments, than ſcholaſtic Reaſoning: theſe were again oppoſed in favour of the *Sylvian* Hypotheſis by *Florent. Schuyl*, Botanic Profeſſor at *Leyden*; and in a Treatiſe *de Medicina veterum*, he propoſes an Experiment for its Confirmation, *viz.* "That the Effer-
"veſence of the Bile and pancreatic Juice in the
"living Animal ought not to be denied, becauſe
"thoſe

" thoſe Juices do not appear to effervesce out of " the Animal upon Mixture: but the Experiment " is to be made in the living Animal; therefore " the Right *Hypochondrium* is to be opened in a " living Dog, and a Ligature made on the *Duo-* " *denum* about four Fingers breadth above the In- " ſertion of the biliary Duct, making another Li- " gature on the Inteſtine as many Fingers breadth " below the Duct; then return the *Duodenum* in- " to the *Abdomen*, and let the Animal reſt; and " upon opening him a few Hours after, the In- " teſtine betwixt the Ligatures will be found tenſe, " diſtended, and hot; and upon making an In- " ciſion in it, there is diſcharg'd a Froth and great " Stench; ſo that it is thus manifeſt by ocular " Demonſtration, that the Bile and pancreatic " Juice do effervesce upon mixing in the Animal."

The *Sylvian* Sect triumph'd in this Experiment, ſuppoſing it ſufficient to put an End to the Controverſy; but they ſhould have conſidered, that the ſame Appearances would have been produced by making the Ligatures in any other Part of the Inteſtine, below the Entrance of thoſe Juices, from the Inflammation that would thence ariſe, and from the elaſtic Air generated by the Fermentation of the intercepted or ſtagnant Chyle. Nor is there the leaſt Appearance of any Effervesſcence upon the Mixture of theſe two Juices in the living Animal without making Ligatures, but the Bile appears to mix and unite ſmoothly and evenly, without any Commotion, with the pancreatic Juice, upon opening the *Duodenum* in a living Animal: And upon mixing the recent Bile and pancreatic Juice taken from an Ox juſt kill'd, I have often ſeen by Experiment that they unite like Water with Water, without the leaſt Effervescence; to which we may add, that theſe two Juices do not

efferveſce even in thoſe Animals where the pancreatic and biliary Duct are inſerted into each other; ſo that they have an immediate Contact and intimate Mixture; as in Man, and ſeveral other Animals, *viz.* the Fox, Cat, Sheep, Horſe, Elephant, *&c.* Nor do thoſe Animals ſuffer the leaſt Inconveniency in digeſting their Food, or in performing their natural and vital Functions, who have the pancreatic Duct inſerted into the *Duodenum* at a very great diſtance from the biliary Duct; as they are diſtant from each other fifteen Inches in the Rabbit, twenty in the Hedge-hog, and even three Feet in the Oſtrich.

[8] The pancreatic Juice is very thin, the Chyle of the Stomach is thicker, the Juice of the Inteſtines more viſcid, and the cyſtic Bile thicker than them all (for that may be ſometimes drawn out into Threads;) but as Soap does not act till it has been diluted with Water, ſo the Bile cannot exert its Efficacy till it has been firſt diluted with the pancreatic Juice; and this is the chief reaſon why the pancreatic Duct diſcharges its Contents into the *Duodenum* at the ſame Aperture, or very near, with the Duct of the Bile, in much the greater Part of Animals. And in rapacious Birds, which ſeldom or never drink, this Juice ſeems to perform the Office of that Liquor.

[9] By mixing with the Bile, it ſcowrs off the Glue of the Inteſtines, and diſſolves the groſſer Particles of the Aliment, ſo as to render them paſſable thro' the ſmaller Orifices of the Lacteals.

[10] It ſo dilutes the Bile, that notwithſtanding it is mixed in ſo large a Quantity with the Aliment, yet it leaves no Bitterneſs either in the Chyle or Fæces, nor even in the Contents of the *Ilium*; towards its lower end, notwithſtanding, it tinges the Contents of the Inteſtines with a manifeſt yellow Colour,

Colour, for the hepatic Bile is naturally much thinner, and diſcharged more plentifully than the cyſtic Bile; and then the cyſtic Bile is diluted with the pancreatic Juice, in the ſame manner as a large Quantity of Milk obſcures a little Bitterneſs of Wormwood, or the Acrimony of Mercury ſublimate; yet we ought not to conclude from thence with *Helmont*, that the Bile does not tinge the Fæces of the large Inteſtines; for as long as it is ſecerned in its due Quantity and Strength, the Fæces are tinged yellow by it, and the more intenſely as the Bile is ſtronger; but upon an Obſtruction of the Bile, the Fæces are diſcharged of a white Colour, as we obſerve in a Jaundice: it alſo ſeems not improbable, that the Strength of the Bile may be overcome by the larger Quantities of Chyle, pancreatic and inteſtinal Juices; ſince it is apparent from Experiment, that different Liquors do upon mixture inſtantly change their Taſte and other Properties; thus the Bitterneſs of Silver diſſolved in *Aqua fortis*, is ſuddenly deſtroyed upon mixing a little common Salt, the Silver being precipitated to the bottom of the Veſſel, and the remaining Liquor render'd very ſaline.

[11] This is one of the principal Qualities of the *Saliva*; the Cow makes the ſame ſweet and pleaſant Milk from all Sorts of Herbs, both acid, bitter, and aromatic; and a Woman gives the ſame Milk from all Sorts of Food, except ſuch as are ſpirituous, and poſſeſſed with a particular aromatic Pungency; which Change is owing to the Mixture of our other Fluids with the Aliment; to wit, the *Saliva*, Juices of the *Pancreas*, Stomach, and the Bile.

[12] There is not ſo much as a Dram of the whole three Pounds of the pancreatic Juice, which are daily diſcharged into the Inteſtines, conveyed out with

with the Fæces of the Inteſtines of a healthy Body, which are in that State very dry; it muſt therefore be again abſorbed into the Veins or lacteal Veſſels; and as its Paſſage with the Blood is performed in a very ſhort time, it may be again ſecerned and abſorbed above a hundred times in a few Hours, returned with the Blood to the Heart, and again diſcharged by the cœliac Artery into the *Duodenum*, under the Name and Appearance of pancreatic Juice.

§. 102. From hence one may be enabled to give a rational Anſwer, whether there are more than *two Sorts* [1] of Bile; whether the Bile is an *Excrement* [2] of the Chyle ſent to the Liver, ſeparated while Blood is made thereof in that Part; *whether or no* [3], and *how far* [4], it is ſerviceable in preſerving Health, and continuing the ſeveral Actions of Life; whether the Juice of the *Pancreas* and Bile will admit the Hypotheſis of *Helmont* or *Sylvius* [5]; or whether they were both miſtaken; whether they are the Cauſe of Life, by exciting and maintaining an *inteſtine Motion* [6] in the Blood; what is the Nature of the pancreatic Juice, and what its Office; why it flows into the *Duodenum*, together with (or at leaſt very near) the *Bile* [7]. And laſtly, whether the Animal cou'd ſubſiſt well *without it* [8].

[1] We do not enquire ſo much whether there be two Sorts of Bile in the Liver, diſtinct from each other, the cyſtic and hepatic, as whether there be another, diſtinct from both of them, diffuſed thro' the whole Maſs of Blood. The Foundation of this

Controverſy, which has occaſioned the Moderns to depart from the Ancients, is as follows. We find that Blood diſcharged in Phlebotomy, quickly turns into a hard Cake, diſtinct from its *Serum*; which laſt is naturally tinged of a yellow Colour, by what the Ancients called yellow Bile; the upper Part of the Cake of *Craſſamentum*, which is expoſed to the Air, appears of a bright Red, and is more ſtrictly denominated *Cruor* or Blood; but the lower Part of the *Craſſamentum*, which is next the bottom of the Veſſel, appears darker or blackiſh, and is called by the Ancients *Atrabilis*; and laſtly, the whey'ey Part of the *Serum*, which ſometimes looks milky, they denominate its *Pituita*, or Phlegm. Theſe they made the four primitive Humours; among which was the two Kinds of Bile, yellow and black; but the Name of Bile was apparently abuſed in that reſpect; for the Yellowneſs of the ſerous Part of the Blood proceeds from the large Quantity of red Globules mixed with Water, the upper Surface of the Blood appears redder, and more ſplendid from its Situation, being in Contact with the Air, becauſe the ſame grows black again, if it be inverted towards the bottom of the Veſſel; but neither Part has the leaſt Sign of Bile, nor is there any Quantity or Proportion of that Humour diſtinct from the Blood, the difference ariſing from the chief and largeſt Part of the Blood itſelf.

[2] The Ancients ſuppoſed that the Chyle was drawn to the Liver by the Attraction of the meſeraic Veins, and elaborated by the digeſtive Faculty of that Organ; by which Faculty it was alſo converted into Blood, and that the Bile was ſeparated at that time as an Excrement of the Blood, and conveyed into the common biliary Duct. All which might be admitted, if the digeſtive Faculty of the Liver be interpretated in a proper Senſe, except that

that the Chyle is not conveyed to the Liver, nor converted into Blood there; tho' it is not to be denied, but that ſome Part of the Bile may paſs to the Liver, after being abſorbed by the meſeraic Veins.

[3] The Bile has many conſiderable Uſes in the human Body, inſomuch that Health and a good Conſtitution greatly depends upon a due Secretion of this Juice; which when vitiated, either in Quantity or Quality, cannot fail of producing obſtinate Diſorders. The Bile is one of the principal Inſtruments in Chylification; for want of a ſufficient Quantity of this Fluid in the Jaundice, Crudities and acid Indigeſtions of the Aliment, with whitiſh or grey-coloured Fæces are occaſioned in the *Primæ Viæ*; by ſtagnating in the Liver, it forms *Calculi* in the common Duct of the Bile, and of the Gall-bladder; which obſtructing its Paſſage, renders the Chyle crude and undigeſted; but when too much putrified or acrimonious, it occaſions Diarrhæas, Dyſenteries, putrid Fevers, and various other malignant Diſorders.

[4] *Helmont* wrote before the Diſcovery of the Blood's Circulation; and if he had lived much longer, at that Age, he wou'd have been unwilling to have changed his Syſtem, which he had once formed, nor cou'd he well have departed from it: But as there was nothing but the Circulation of the Blood which cou'd give Riſe to the Heat in the human Body, and as the Food, tho' cold and inanimate, did at laſt obtain the like vital Heat, and as ſuch Things as were acid were converted into a volatile Nature, that eminent Chemiſt was not ſenſible of any other Means of explaining ſo different a Change than by Fermentation or Mixture of contrary Principles, by which Heat and Motion might be communicated thro' the whole Body; for *Helmont* had found by

Experience that a conſiderable Heat might ariſe from the Efferveſcence of cold Bodies, as of Oil of Vitriol with fixed Salt of Tartar, which occaſions a ſtrong Heat; he alſo had read in *Fernelius*, that the *Pancreas* was the Seat of chronical Fevers; that a ſort of Juice was prepared in that Body, which afterwards mixed with the Aliment; and that as the Bile, which is ſo extremely bitter, was alſo mixed with that Juice and the Aliment in the ſame Part, he was eaſily perſuaded that an Efferveſcence muſt be occaſioned from the Mixture of thoſe Liquors in the *Duodenum*, which imparted Heat and Motion to all the reſt of the Machine.

5 Thoſe Errors were more excuſable in *Helmont* than in *Sylvius*, who was an expert Anatomiſt, and well acquainted with the Circulation of the Blood; and yet ſo deſirous was he of imitating *Helmont*, that he ſuppoſed a Fermentation, not only of the Bile and pancreatic Juice of the *Duodenum*, but alſo another Efferveſcence to be made in the Right Auricle and Ventricle of the Heart, upon the Mixture of the Chyle, Lymph, and pancreatic Juice; Liquors ſuppoſed to be of an acid nature, with the volatile and fetid Bile and the Blood, which were alcaline; and that from this Efferveſcence aroſe all the vital Heat and Motion of the Heart and reſt of the Body; alſo that it was neceſſary for the Preſervation of Life, that there ſhould be a perpetual Conflict of an alcaline with an acid Salt: but it has before been largely demonſtrated that healthy Bile is not alcaline, and that the pancreatic Juice is not acid; to which we may alſo add, that an Animal may live entirely without the pancreatic Juice, like thoſe who live entirely upon aceſſent Milk, or entirely upon alcaleſcent Fleſh of Animals; from whence it will evidently appear, that the imaginary Conflict or Efferveſcence of thoſe Liquors

Liquors which they ſo confidently maintained, is without any manner of Foundation.

[6] We before obſerv'd, that *Sylvius* attributed the inteſtine Motion of the Blood to an Efferveſcence between acid and alcali; to wit, the acid Liquor of the thoracic Duct, formed of the pancreatic Juice, Chyle and Lymph intermix'd, and afterwards poured into the alcaleſcent Blood; which contrary Liquors beginning their Efferveſcence in the *Duodenum*, did not ceaſe it even in the Right Auricle and Ventricle of the Heart; but if it did occaſion ſo ſtrong an Efferveſcence in the *Duodenum*, it is hardly intelligible by what means that Efferveſcence ſhould be continued thro' ſo many Turnings and Windings, eſpecially after being diluted with ſo large a Quantity of an inſipid Lymph in the Receptacle of the Chyle and thoracic Duct; nor can ſuch a Force be by any means equal to the Cauſe of ſo ſtrong a Motion as that with which the Blood is projected by the Heart; it rather ſeems ſurpriſing that Men of ſo much Knowledge and profound Underſtanding ſhould propoſe ſuch falſe Syſtems, and thence deduce ſuch abſurd Conſequences.

[7] The ſaponaceous Quality of the Bile is aſſiſted by being diluted with the pancreatic Juice, in order to mix the Chyle; in the ſame manner as greaſy Wool is eaſily cleanſed with Soap, by diluting and waſhing in warm Water, but not ſo well in cold Water; and not at all, if it were to be ſcowred with hard Soap only, without the addition of ſome diluent Liquor.

[8] This ſeems to be countenanc'd by ſeveral Experiments made by an ingenious Perſon, who entirely cut out the *Pancreas* from ſeveral Dogs, who yet continu'd to live without any ſenſible Inconvenience. The want of the pancreatic Juice in thoſe

Animals ſeems to be ſupplied by a more plentiful Secretion of the *Succus gaſtricus*, and of the Inteſtines, particularly the *Duodenum*; but it alſo does not appear that thoſe Dogs liv'd without any Inconvenience, if they ſurvived the Operation any conſiderable Time; but that they frequently were ſubject to Obſtructions, Strumous Glands, and a ſort of hectic Fever. The Obſervation of *Brunnerus*, that he had more than once found the pancreatic Duct, which he had before divided, again renew'd, ſeems to argue, that this Juice is not only uſeful, but neceſſary to the well-being of the Animal. Nor could that Liquor be deemed uſeleſs, becauſe the Abſence of it does not preſently incur violent Diſorders upon the Animal. Even what reaſonable Perſon would affirm the Spleen to be uſeleſs, becauſe a Dog may ſurvive after the Extirpation of that *Viſcus?* It even cannot be affirm'd, that the moſt ordinary and ſeemingly inſignificant Parts of the human Body have not their proper Uſes; for that would be detracting from the divine Wiſdom of the ſupreme Architect, who has ſo exquiſitely built the human Body, that it ſeems to be the greateſt Example of Perfection amongſt the ſublunary Beings. There are more than a few Hiſtories extant of Patients ſurviving the Loſs of a Limb, a Lobe of the Lungs, one of their Kidnies, *&c.* But would any Body therefore pronounce thoſe Parts to be uſeleſs? *Brunnerus* proves this indeed, that the *Pancreas* is not ſo immediately neceſſary to Life as *Sylvius* would have it; but does not make it appear, that the Animal from whence that *Viſcus* was extirpated, continu'd to live in as perfect Health as before it was deprived of the ſame *Viſcus*.

Concerning the Propulſion of the Chyle into and thro' the lacteal Veſſels.

§. 103. BY the Contraction of the *longitudinal*[1] Fibres of the Inteſtines which are inſerted into their external Coat as into a Tendon, the inteſtinal Tube is thereby wrinkled in that Part oppoſite to the Meſentery, which therefore reduces them from a ſpiral to a cylindrical, or ſtraight Form; by this means the Inteſtines are relaxed on that Side connected to the Meſentery, but contracted on the oppoſite Side, whereby the ſmall *Orifices*[2] of the Lacteals, that lie next the Meſentery, are ſo opened and dilated, as to receive the more fluid, moveable, and ſlippery Particles of the Chyle, which there meet with a ready Entrance: In the mean time the Valves of the Inteſtines will be enlarg'd, made more prominent, and brought cloſer to each other by the ſame Contraction, ſo as to intercept and ſtop the *Chymus* in its Paſſage, and almoſt entirely ſhut up that Part of the Inteſtine thus moved or contracted. All which is more exactly performed in the *Jejunum*, where the Valves are more frequent, prominent, and circular, the *Lacteals*[3] more numerous, the Contraction of the agitated Stomach is more ſenſible, and the Chyle more diluted, quickly paſſing along by its Mixture with the *Saliva*, *Succus gaſtricus*, Juice of the *Pancreas*, and the two Kinds of Bile.

[1] Thoſe longitudinal Fibres which are ſeated in that Part of the Inteſtines connected to the Meſentery, are not inſerted into the external or common Coat of the Inteſtines, ſo that there is no Contraction in that Part which is ſupplied with the cellular Membrane; but thoſe longitudinal Fibres which are ſituated in the oppoſite convex Side of the Inteſtines, fartheſt from the Meſentery, being faſten'd to the external Coat, they contract the Inteſtines from their arch or ſpiral Form to a ſtrait cylindrical Figure; and by rendring them ſhorter, contract them into Wrinkles; but while the circular Fibres are contracted, at the ſame time the internal Cavity of the Inteſtine will be leſſened, and the Valves brought into mutual Contact with each other; by which means the Chyle will be protruded into the lacteal Veſſels, much in the ſame manner as Quickſilver is preſſed thro' Leather. The muſcular Fibres of the Inteſtines may alſo be aſſiſted in their Action by the Preſſure of the abdominal Muſcles, which is ſtronger upon them where they are uncover'd by the *Omentum*, and touch the *Peritonæum*; but leſs on that ſide of them which is connected to the Meſentery, and therefore the Chyle will be preſſed towards the lax Part of the Inteſtine.

[2] Beſides the lacteal Veſſels opening into the Inteſtines, the meſenteric Veſſels alſo open into that Cavity with ſuch large Apertures, as to tranſmit the ceraceous Injection of *Ruyſch* into the Inteſtines; but the lacteal Veſſels open moſt plentifully in that Part of the Inteſtines towards the Meſentery, but fewer on the Sides, as I have frequently obſerved; but they are ſo diſpoſed, as not to admit any thing from the Inteſtines, only in the time of Digeſtion, when they are found full in living Animals; at which time the Lacteals have

been alſo ſeen by ſome of the Family of *Æſclepiads*, as *Galen* informs us. *Aſellius* alſo conſtantly found, and deſcribed thoſe Veſſels in living Animals, which had been open'd a few Hours after a Meal; but the Ancients being ignorant of the Receptacle and thoracic Duct of the Chyle, and being prejudiced in favour of the Liver, imagin'd that they convey'd the Chyle to that *Viſcus*. A Diſſolution of Indigo-blue in recent Urine being forced into the Inteſtine of a living Animal between two Ligatures, may by Preſſure be forced into the Lacteals.

[s] Theſe are real Veins, if by Veins we intend ſuch Veſſels as return their contained Liquors towards the Heart.

§. 104. The orbicular Fibres of the Inteſtines, inſerted into the Meſentery as into a Tendon, being at the ſame time contracted, they diminiſh the Diameter or cylindrical Space of the Tube, and preſs the Valves together, which were before drawn nearer to each other; by which means the Chyle being compreſſed, mixed, diluted, agitated, and intercepted in its Paſſage, is by the Force of the ambient Parts protruded chiefly towards the Meſentery, and there driven into the Mouths of the Lacteals, opening into every Point of the Inteſtine, having been before opened by the *periſtaltic Motion* [1] for the Reception of the Chyle; therefore the Chyle does not appear to enter the Lacteals by its own Weight, or by the Force of any *Effervеſcence* [2].

[1] Upon

[1] Upon a Ceſſation of this Motion, the Motion and Abſorption of the Chyle alſo immediately ceaſes; which is quickly performed, ſo long as the periſtaltic Motion continues; for the Lacteals, which are viſible in opening a living Dog, do not remain ſo long, but vaniſh almoſt in the Twinkling of an Eye, by diſcharging their Contents towards the Receptacle, and being fill'd with Lymph. To this we may add, the Obſervation of the Lacteals remaining viſible a long time in ſuch as have been hang'd, from the Chyle being ſtopt in the thoracic Duct by the Compreſſure of the Ligature.

[a] This is an Opinion of *Sylvius*, or a falſe Deduction from a falſe Hypotheſis; for the Inteſtines at that time when the Efferveſcence is made, will have their Sides diſtended into a larger Circle, their Valves will be flatten'd, their pendulous *Villi* will be contracted and ſhorten'd; therefore no Chyle will be abſorbed by the Lacteals while the Inteſtines are in their utmoſt Diſtenſion: on the contrary, it is apparent that the Chyle is abſorbed by the Lacteals, not in the contracted, but in the relaxed Part of the Inteſtine, oppoſite to the longitudinal Fibres, the Chyle being propelled into the Lacteals by the Contraction of the annular Fibres acting towards the Meſentery: it is alſo manifeſt, that the Lacteals are not filled by any internal Force, but by an external Preſſure; becauſe upon diſtending them with Wind, no Part of the *Flatus* will enter them: to which agrees the Experiment made by the Royal Society, of forcing a Diſſolution of Indigo-Blue into the Lacteals by Preſſure: it has been alſo before demonſtrated (§. 93. N 1.) that the moſt natural State of the Inteſtines comes neareſt to a Contraction of them.

§. 105. From

§. 105. From hence it appears, that the Chyle which enters the Mouths of the Lacteals, is improperly eſteemed to be a Compoſition of the ſolid and fluid Aliment only; for it alſo conſiſts in a great meaſure of the *Saliva* [1] (§. 66.) and the thin *Mucus* of the Mouth (§. 65.) with the *Mucus* and thin Liquor of the *Oeſophagus* [2] (§. 73.) and Stomach, in conjunction with the cyſtic and hepatic *Bile* [3] (§. 98, 99.) the pancreatic Juice (§. 101.) with the lymphatic Humour of the *Inteſtines* [4] and mucous one of *Peyerus*, and perhaps a more ſubtle Liquor plentifully diſcharged out of the infinite Number of ſmall *Nerves* [5] which terminate in the Inteſtines; for all theſe Humours, which are either ſwallowed, or are diſcharged and tranſuded into the Capacity of the Stomach and Inteſtines, always enter the Lacteals, either alone or mix'd with the moſt fluid Part of the Chyle, notwithſtanding the lacteal Veſſels are only *conſpicuous* [6] after a Meal.

[1] We have before obſerved from *Nuck*, that 12 Ounces of *Saliva* are ſeparated and diſcharged into the Mouth in the Space of four and twenty Hours; but the Quantity of ſalival Juice which is abſorbed by the Lacteals in that time is ſtill much larger; for all that which was ſpit out in the Experiment of *Nuck*, wou'd have been abſorb'd by the Lacteals, and again ſeparated by the ſalival Glands ſeveral times in the Space of a Day; and therefore it is probable that ſeveral Pounds of *Saliva* paſs daily thro' the Lacteals.

[2] That the Quantity of both theſe Juices is not inconſiderable, will appear from the Size of the

Organ and Laxity of the Veſſels which open freely into the Cavity of the *Oeſophagus*.

[3] The large Quantity of this bitter Juice may be eaſily eſtimated. The Liver is an exceeding large *Viſcus*, and its Veſſels ſo lax, that Water being injected by the *Vena Portæ*, finds a ready Paſſage into the *Cava*, and runs thro' the common Duct of the Bile; its Veſſels are alſo very large, if we conſider the great Diameter of the *Vena Portæ*, and its excretory Duct very capacious; if we therefore compare the Secretion made in the Kidnies, which ſeparate no leſs than three Pound of Urine every Day, with the Secretion of this large *Viſcus*, it will appear that not a few Pounds of the hepatic Bile are ſecerned daily in the Liver.

[4] But the ſerous Secretion made in the Inteſtines from the meſenteric Arteries is ſtill much greater; for thoſe Veſſels are not only very large, but alſo very lax and open, ſo as readily to admit the ceraceous Injection of *Ruyſch* to paſs freely into the Cavity of the Inteſtines: Theſe excretory *Arteriolæ* are alſo ſometimes the Cauſe of Diarrhæas, when no Aliment is taken, thro' a Loſs of Appetite. M. *Rede* has obſerved in his Diſſections of Animals in *Florence*, which have been ſtarved to death with Hunger, that the Inteſtines have been relaxed; and the lacteal Veſſels full of Lymph, by their abſorbing theſe Juices.

[5] The Diſcharge made by the ſmall Nerves of this Part is not therefore inconſiderable, becauſe it cannot be demonſtrated to the Eye-ſight; for we ſee that a ſtrong Man in froſty Weather continues to perſpire a ſubtle Vapour thro' the contracted Veſſels of his Skin ſo plentifully, as to make five Parts out of Eight of all his Diſcharges in the Space of four and twenty Hours; which is evinced by *Sanctorius*, and confirmed by Experience; but the great

great Number of ſmall Nerves which open into the Cavity of the Inteſtines, which are conſtantly warm, and compoſe a ſecretory Organ above threeſcore Hands long, ought greatly to exceed in their Secretion of a ſubtle and moiſt Vapour.

[6] The ſeveral Juices which we have before enumerated, are not at all diſcharged with the Fæces in a natural and healthy State of the Body, but are abſorbed, and again conveyed into the Blood; but there is only one way for them to paſs thither, *i. e.* by the lacteal and meſenteric Veins; therefore the ſeveral Juices which are continually poured into the Inteſtines entirely paſs thro' thoſe Veſſels without any Chyle when we are faſting, by which they are conveyed to the venal Blood, with that Blood into the Heart, and thence again into the Inteſtines. It is but a ſmall Objection, that the Lacteals of a faſting Animal are not conſpicuous, for that ariſes from the Smallneſs of thoſe Tubes, and the Pellucidity of their Contents at that time; even lymphatic Veſſels, which are much larger than the thoracic Duct, are ſeldom viſible upon the ſame account, if they are not tied; but yet no rational Perſon will deny the Paſſage of a Fluid thro' thoſe Veſſels.

§. 106. We may therefore aſk in this place, whether the thinner, bilious, and more lymphatic Part of the Chyle is not abſorbed by *bibulous Ducts* [1], which open into the villous Coat of the Inteſtines, and diſcharge their Contents into the meſeraic Veins, thence paſſing with the Blood of the *Venæ Portæ* into the Liver, and affording freſh Supplies of new Matter for the Secretion of Bile. This Queſtion is certainly anſwered in the Affirmative, by conſidering the great Number, *Size* [2], *Structure* [3],

Eture 3, and *Office* 4 of all the Veins, particularly ſpent upon the Inteſtines, from the Paſſage of their venal Blood into the *Porta*, as into an *Artery* 5, from the bilious Nature or *Diſpoſition* 6 of their contained Blood; and from the large Quantity of *Juices* 7 diſcharged into the Inteſtines, which are neither obſerved to be entirely abſorbed by the Lacteals, nor yet expelled with the Fæces; to which we may alſo add the Arguments taken from comparative Anatomy in *oviparous Animals* 8, where the Chyle paſſes freely from the Cavity of their Inteſtines into the meſeraic Veins, there being no Lacteals found in thoſe Creatures; to which add the patulent Openings of the ſmall Branches of the meſenteric Veins into the villous Coat of the Inteſtines in the human Body, the Abſence of Valves in thoſe Veins in the human Subject, with the ready Paſſage of the ceraceous Injection of *Ruyſch* into the Cavity of the Inteſtines, upon injecting the meſenteric Veins; when the Inteſtines are contracted by the periſtaltic Motion, the meſenteric Veſſels are ſurpriſingly curled and twiſted.

1 It is no difficult Matter to prove a free Paſſage from the Inteſtines into the meſeraic Veins, inaſmuch as Water and ceraceous Subſtances being injected into thoſe meſenteric Veins, readily paſs thro' them into the Cavity of the Inteſtine, and tranſude thro' every Part of their villous Lining; ſo that it is more than probable that the moſt fluid and aqueous Parts of the Contents of the Inteſtines are abſorbed by them; but it is no more ſurpriſing that the ſmall Mouths of thoſe Veins ſhou'd not be conſpicuous

ſpicuous to the Sight, than that the Orifices of the lacteal Veſſels ſhou'd not be viſible even by the beſt Microſcope.

[2] The Veins of the Inteſtines are much larger, and more numerous than the correſponding Arteries; but the Arteries depoſit a conſiderable Quantity of a thin Fluid, by their ſtrong Contraction, into the Cavity of the Inteſtines; therefore the Veins ought to carry back leſs than was convey'd by the Arteries; and therefore they ought to have been ſmaller, and leſs numerous, if they were not to receive other Supplies; which required the Trunks of the Veins to be much larger than thoſe of the meſenteric Arteries.

[3] Every Branch is convoluted into Waves or Arches, from the convex Part of which are continued ſmall Branches in a ſtrait Courſe to the Inteſtines; which Structure being peculiar to the inteſtinal Tube, ſeems to import, that ſomething is performed in thoſe Veins more than is uſual in thoſe of other Parts; but the other Veins of the Inteſtines which come from the *Cava*, take a different Courſe, and paſs in ſtrait Lines to their Terminations in the Form of ſmall Pencil Bruſhes; but what ſhou'd be the Cauſe of this Variation in their Structure, if it is not what we have here aſſigned?

[4] The common Office of the Veins is to receive and convey a Fluid to the Heart, whether that Fluid be received from the Arteries, or abſorbed from ſome Cavity in the human Body, or drank in from the external Air? The Veins which receive their Fluid from the Arteries, are the ſanguiferous, or red Veins; thoſe which abſorb from peculiar Cavities, or glandular Cells, are the bibulous Veins of the *Omentum*, Ventricles of the Brain, of the Stomach, Mouth, and Inteſtines, of which laſt we are here ſpeaking; but it is apparent that the

the Branches of the *Venæ Portæ*, which come from the Inteſtines, ought to be numerated among thoſe abſorbing Veins, from the Experiment of their tranſmitting Injections into their Cavity; therefore if theſe Veins open into the Cavity of the Inteſtines, and if their Office is to convey a Fluid from their Origin towards their Baſis, it muſt neceſſarily follow that they receive ſome of the fluid Parts of the Chyle contained in the Inteſtines, and conveyed with the Blood towards the Heart; nor is there any reaſon why any Body ſhould deny the Ingreſs of Fluids, which have a Communication with the patulent Orifices of the abſorbing Veins; for even the callous Skin of the bottom of the Feet ſo powerfully abſorbs the mercurial Ointment, that this was the firſt and moſt ancient Method of curing the Venereal Diſeaſe by Unction; and Inſtances are not wanting where the *Mercury* thus abſorbed has reſumed its globular Appearance, and ſtopt in the *Diploæ*, between the Plates of the *Cranium*, after having cauſed a laſting and violent Head-ach. It is alſo the common Office of the ſanguiferous Veins to receive thin Fluids, ſince all the Lymphatics are diſcharged into thoſe Veins; and therefore upon tying a ſanguiferous Vein, the Lymphatics become turgid, and more viſible: but the lymphatic Veſſels receive a great Part of their Fluid from various Cavities or Cells in the human Body; for it is reaſonable to ſuppoſe, that the Liquor of the *Pericardium*, that in the *Abdomen*, *&c.* are conſtantly abſorbed; ſince if they were to be perpetually diſcharged, and not returned, a Dropſy muſt enſue. *Nuck* infuſed two Pound of Water into the Cavity of the *Abdomen* of a Maſtiff Dog, and upon opening the Animal ſome time afterward, there was none of the Water to be found; it is therefore nothing extraordinary or diſagreeable with the Nature

Nature of Veins, if the abſorbing Veſſels of the Inteſtines drink up ſome of their moſt fluid Contents, and tranſmit them into the ſanguiferous Veins.

[5] The *Vena Portæ* propels the Blood of the abdominal *Viſcera*, like an Artery into the *Sinus* and Veins of the Liver, by which Force the Bile is propelled into its proper Ducts, and the Blood thro' the *Anaſtomoſes* of the *Vena Cava*; and it ſeems altogether probable, that as the Heart diſtributes all the Blood to the ſeveral Parts of the human Body, ſo the *Porta* alſo diſtributes the ſeveral Humours of the *Abdomen* to the Liver; but as the Blood is diluted with all the lymphatic and thinner Juices of the Body, before it paſſes thro' the ſmall Veſſels of the Lungs, ſo in like manner the Blood of the *Porta* ſeems alſo to be diluted before it enters the ſmall Veſſels of the Liver.

[6] The Blood of the meſenteric Veins is of a browniſh yellow Colour, and hardly congeals, but appears fluid when extravaſated, like other Blood in the Air, appearing rather the Conſiſtence of Lard, while the Blood of the Arteries appears of a bright ſhining Red, and quickly congeals; therefore if the meſenteric Veins received nothing but the arterial Blood, it ſhould, like the Blood of other Veins, become black, thick, and quickly congeale into a hard Cake; but as this is not the Caſe, and their Blood appears more dilute, thoſe Veins muſt conſequently receive ſome other Fluid beſides that of the Arteries.

[7] There are People who drink 12 Pounds of Spaw-water in a Morning, without diſcharging any Part thereof by Stool, the whole Quantity being convey'd into the Blood from the Stomach and Inteſtines, and paſſed off by Urine; but the Nature of thoſe Waters is to exert a conſiderable Force

upon the Liver, which is the reaſon why we frequently order them in the moſt obſtinate Diſorders of that *Viſcus*. As thoſe Veins are deſtitute of Valves, and have a free Communication with the Cavity of the Inteſtines, they frequently occaſion purulent Diarrhæa's, diſcharging the whole Subſtance of the corrupted Liver, ſo as to leave nothing but its membranous Integuments behind, like an empty Bag. If to theſe Conſiderations we alſo add the immenſe Quantity of the ſeveral animal Fluids which are convey'd into the Inteſtines, and are not at all diſcharged with the Fæces, but returned by the abſorbing Veins, it will appear altogether neceſſary that there ſhould be more Veſſels than the Lacteals, for the Tranſmiſſion of thoſe Fluids.

[8] Birds, and the reſt of the oviparous Claſs of Animals, are deſtitute of Lacteals, which would have been in danger of growing together by long faſting; all the Chyle in thoſe Animals is taken up by the meſenteric Veins, which are ſo open as to receive the Wind with which the Inteſtines are diſtended, by means of a Ligature and an additional Preſſure, ſo as to paſs into the Veins: but it is not reaſonable to ſuppoſe, that a Mechaniſm which obtains in ſo large, or the greateſt Part of Animals, ſhould be entirely excluded from Quadrupeds, or viviparous Animals.

§. 107. If we therefore diſtinctly and ſeparately conſider the ſeveral *Appearances* [1] and Alterations of the ſolid and fluid Aliment from their firſt Entrance by the Mouth, till they have parted with their milky Juice by the Lacteals, the whole Buſineſs of Chylification will appear to be the ſimple Conſequence of the

Structure

Structure and Action of the ſeveral Organs and Veſſels, with the known Nature and Action of the ſeveral animal Juices therein employ'd, being demonſtrable by the Senſes and mechanical Reaſoning; ſo that you may be thence able to judge for yourſelf whether there is any neceſſity for calling in the Aſſiſtance of obſcure and dubious *Hypotheſes* or *Poſtulata* [2], which have neither *Reaſon* nor *Experiment* [3] to ſupport them, to account for theſe Phænomena; ſuch as a vital, innate, or digeſtive Heat and *acrid Ferment* [4] in the Stomach, volatilizing the Food; an operating *Archæus* [5], or ſpiritual Cook; an alcaline Bile, converting the fix'd acid Chyle into a volatile alcaline and ſaline Nature; a fictitious Acrimony in the pancreatic Juice *fermenting* [6] with the alcaleſcent Bile; a Depuration of the Chyle by a *Precipitation* [7] of its Fæces, equally falſe and imaginary with the *peripatetic* [8] Qualities and *galenic* Faculties, with the *Ferment, Ebullitions, and Effervеſcencies* of the Chemiſts; and the innumerable other falſe and *pernicious* [9] Hypotheſes miſleading from the Truth. A Perſon may hence alſo be able to judge why the *periſtaltic Motion* [10] is performed only in the ſmall Inteſtines; and why that Motion continues in a *deliquium Animi* [11]; and even after Death, when the Inteſtines have been removed from the Body for ſome time; whether it is not extreamly neceſſary to urge the Parts in a *Syncope* to their former Action for continuing Life; and whether or no this Motion is not compoſed of a

Syſtole and *Diaſtole* of the Cavity of the Inteſtines as in the Heart.

[1] That is, the whole Buſineſs of Chylification, or that Function of the human Body whereby the ſolid and fluid Aliments are reduced to a thick, ſweet, and milky Juice, paſſing into the Lacteals; the Cauſes of which Changes in the Food, reſide partly in the Aliments themſelves, and partly in the Action of the ſeveral ſolid and fluid Parts of the human Body, which we have hitherto deſcribed as acceſſary to that Office.

[2] By *Poſtulata* we underſtand ſuch evident Truths as need no Proof, and may be ſafely relied on for certain; notwithſtanding other obſcure and imaginary Deductions may thence be framed: which *Poſtulata* in Phyſic ought to be no leſs evident, than the Appearances to be explained by them, otherwiſe they are to be rejected; they differ from Hypotheſes, in that the latter are only Suppoſitions, without any evident Proof; whereas *Poſtulata* are certain and evident Propoſitions, but not yet demonſtrated; yet they muſt be allow'd equally true as Demonſtration itſelf.

[3] By Experiments we underſtand an Obſervation of the Changes in natural Bodies by our Senſes, which always appearing in the ſame manner is the Baſis upon which all true Reaſoning is founded; thus we are acquainted by Experience with ſome of the Appearances of the Body, as that it is extended in three, and no more Dimenſions, *&c.* upon which Phænomena we build a large Part of our phyſical Reaſoning; but if we truſt more to Reaſoning than Experience, we then become liable to Falacy.

[4] All the known Vegetables which are employed in human Affairs, afford a fixed alcaline Salt by Calcination;

Calcination; but the ſame Vegetables being diſſolved by the Action of the digeſtive Organs in a healthy human Body, do not afford one Grain of a fixed, but a conſiderable Quantity of volatile alcaline Salt. When *Helmont* obſerved this Change, which muſt certainly be more than a little ſurpriſing to a Chemiſt, appriſed of the Difficulty there is in Nature of converting a fixed into a volatile Salt, he pitch'd upon an Example or Compariſon of the *Sal purgans Sennerti*, where a fixed Alcali being mixed with a volatile acid Spirit, is ſublimed into a volatile Salt; he was therefore perſuaded that an acid Ferment muſt reſide in the Stomach, which volatilized the fixed Salt of the vegetable Food: but this Hypotheſis has before been too largely confuted; for there is no ſuch thing as an Acid in any Part of the human Body, except what is taken in from the Food; and many People who feed entirely upon Fleſh and Fiſh, without any acid or aceſſent Subſtance, form the ſame Blood and Juices with thoſe that feed upon Vegetables; nor is it any Matter of conſequence, whether we uſe aceſſent or alcaleſcent Food, ſince good Chyle may eaſily be made from both under proper Circumſtances.

' The Word *Archæus* among the Ancients originally ſignified the firſt Being of all Things; but the Word was formerly abuſed by *Baſil Valentine*, after whom the Chemiſts uſed it to ſignify that Faculty of organic and vegetating Bodies, whereby they converted other Subſtances into part of themſelves. In this Senſe the Term *Archæus* was receiv'd by *Paracelſus*; and *Helmont* more expreſly uſes it to ſignify a Being between that of the conſcious Mind and inactive or common Matter, which directed all the Functions of the human Body in health, cured Diſeaſes, and ſometimes

cauſed them, *&c.* Thoſe Philoſophers thought it neceſſary to frame ſuch an Hypotheſis, becauſe the human Body appeared to them ſo admirably and mechanically built, and ſupplied with various Artifices, that they thought it impoſſible ſo many different Actions, variouſly depending upon one another, ſhould be performed without the Aſſiſtance and Regulation of ſome intelligent Being; but they were not willing to attribute that Office to the immaterial Soul, becauſe it would from thence follow, that we muſt be ſenſible of every Action performed within us, and that we muſt even be capable of governing the ſeveral Functions which we term vital. It is not neceſſary, and therefore we ſhall not give ourſelves the Trouble to confute this Hypotheſis. But it ſeems hardly credible that *Helmont* madly believ'd all to be true that he wrote upon the *Archæus*; and when he ſays, that the *Archæus* craves, chuſes, digeſts and expels the Aliment, he ſeems to intend no more, than that the Food is deſired, ſelected, digeſted, and expell'd by ſome unknown Power. But one might as well confeſs their Ignorance of the Cauſe of any Action, as attribute it to ſome imaginary and unknown Being, of whoſe Exiſtence, Nature, Actions, and Manner of Operation, we have not the leaſt Knowledge or Aſſurance; we are indeed ſenſible that the Cauſes of many Functions in the human Body are merely mechanical; and we alſo know in general, that Life, Health, and all the Actions of the human Body, proceed from the conjunct Action of innumerable phyſical Cauſes, aſſembled in ſuch a manner into one united Body and Mind, as to be capable of continuing and reſtoring the ſeveral Offices of the human Machine; nor does it require any more than one original Cauſe to put it in motion; like a Clock, which when once put

in

in motion, will continue the ſame, and perform its ſeveral Actions during the whole Space of Time for which the Wheels and Work are adapted.

[6] The Chemiſts have generally made uſe of Similies, taken from their own Operations, in order to explain the Separation of the fluid and nutritious Juices from the excrementitious and uſeleſs Part of the Aliment; *e. g.* If an Ounce of Silver be diſſolved in *Aqua fortis*, the Liquor appears uniform, limpid, and bitter to the Senſes; but if Spirit of Salt be poured into that Solution, there ariſes a Commotion, and the Silver precipitates to the bottom, reduc'd to the Form of what they term a *Calx*.

[7] Much in the ſame manner *Verheyn* imagined the Food was diſſolved in the Stomach by an acid *Menſtruum*, which upon mixing with alcaline Bile, occaſioned a Fermentation, at which time the moſt ſubtil and fluid Part, which had acquired a volatile ſaline Nature, was impelled into the Veins, while the more groſs, uſeleſs, and heavy Parts were converted into Fæces, *&c.* But all this Scheme falls to nothing, upon demonſtrating that no ſuch Efferveſcence happens in the human Body.

[8] A Parcel of lazy Philoſophers, who explain'd every thing, as well as Phyſic, by the mere Sophiſtry of the Schools, improperly accounted for Digeſtion by unknown Faculties, as the attractive, retentive, digeſtive, expulſive, and aſſimilating Faculties; but they are not much leſs excuſable than the Chemiſts, who had Experiments to alledge for the improper Deductions or Explanations made from them; whereas the Peripatetics neither made falſe Propoſitions, nor alledg'd Experiments, but entertain'd us with mere Words; which Words may be admitted, if we do not take up with them

for an Explanation of the Appearances, of which they are Names only.

** A Ferment was defined by the ancient Chemiſts to be a Subſtance, which being mixed with another, converted it into its own Nature. Thus a Grain of Wheat becomes augmented in a proper Soil to a hundred, each of which are capable of producing a hundred more; ſo that the ſecond Produce of the firſt will be a thouſand Grains of Wheat, all of the ſame mealy and nutritious Nature: but the ſame Soil will alſo nouriſh very ſtrong Plants, ſuch as *Spurge*, *Euphorbium*, and *Muſtard*; there muſt therefore be ſomething in the Wheat which converts the common nutritious Juice of the Earth into its own particular Subſtance; which would have been quite different in other Plants: but how ſmall is that ſeminal Particle, the whole Grain of Wheat does not exceed the Weight of a phyſical Grain; and if you again ſeparate the Seed-Leaves, or *Placenta*, with the Integuments, mealy Cells, and Radicle, there will then remain a Particle ſo ſmall, as not to exceed a little Grain of Sand; and yet in that Particle, no bigger than a ſmall Grain of Sand, lies conceal'd the Power by which the Juice of the Earth is converted into ten thouſand Plants; a Juice, which in its own Nature is quite different from the Subſtance which it forms: and this Power of Tranſmutation has been denominated by the Chemiſts a *Ferment*. They were indeed excuſable, as being ignorant of the mechanical Structure of the human Body, whereby all Sorts of Aliments are converted into animal Fluids and Solids, and render'd capable of re-producing our Species: but who would believe that a Man may be form'd of Flour and Water, yet we ſee that Children are nouriſh'd and grow therewith: and from the ſame Subſtance,

ſtance, by the Power of the human Body, may be formed *Semen Maſculinum*, which being received into the *Uterus*, re-produces our Species: and in this Senſe the Term may be excuſed, being otherwiſe but little agreeable to the Idea which it expreſſes; but if by the Word *Ferment* we underſtand with the modern Chemiſts, a Subſtance capable of exciting an inteſtine Motion in Bodies, whereby an Alteration or Change is made in their Nature; or if we underſtand by it a Conflict of oppoſite Salts, the Word is then ſpurious, may be the cauſe of Error, and ought to be rejected.

[9] If theſe imaginary Hypotheſes reach'd no farther than the Profeſſor's Chair who ſtarted them, it would be Matter of little conſequence to avoid them, and they would do no great Damage; but they even advance into the Practice of Phyſic, and are often fatal to the Healths and Lives of Patients. Thus the Patrons of an acid Ferment being the chief Cauſe of Digeſtion in the Stomach, deriving Fevers alſo from a Redundancy of the ſame Acid, attempted their Cure by volatile, oily, lixivious, and alcaline Salts; which for a while became almoſt an univerſal Practice, and may ſerve as an Inſtance how the elegant Notions of a Profeſſor may be propagated by his Pupils, to the great Prejudice of the Healths and Lives of the Sick.

[10] By which Motion the Aliment is preſſed backward, forward, and into the lacteal Veſſels; otherwiſe the Aliment would find a ſpeedy Paſſage thro' the Inteſtines out of the Body; but it is ſo retained in their Cells by the periſtaltic Motion, that only the groſſer Parts are propelled into the large Inteſtines, and the more fluid retained in the ſmall ones by a ſurpriſing Artifice, not to be parallel'd by any other Contrivance.

[11] If the Heart of a ſtrong Man ſhould ſtop but one Moment, he falls down, grows cold, appears dead,

dead, his Limbs become ſtiff, and all the ſolid Parts of the Body come nearer into contact with each other, the Fluids being propell'd from all the ſmall Branches of the conical Veſſels from their Extremities towards the Heart. In like manner alſo the Chyle may continue to be propell'd thro' the Lacteals and thoracic Duct into the ſubclavian Vein, by the Force of the periſtaltic Motion, yet remaining: but the Heart is no ſooner irritated by this new Supply, or by any other Means, than it returns to its former Action; and if the Machine is entire, the Man may by that means be revived. In a common *Syncope* we find that the Functions are reſtored by the Aſperſion of cold Water; and there have been ſeveral Inſtances of People who have been given out for dead in a Plague, that have recovered their Life and Senſes upon being expoſed to the Cold, various Agitations, and the ringing of Bells. *Peyerus* having therefore taken the Hint from Nature, produced the like Effect in his anatomical Diſſections, recalling the Heart to its proper Motion by inflating the Veins.

Concerning the Nature and Expulſion of the Fæces.

WE come now to a naſty, but neceſſary Buſineſs, the Expulſion of the Fæces, being one of the Neceſſaries of Life, without which we cannot long ſubſiſt. When the Great *Alexander* was upon his Succeſſes congratulated by his Flatterers with the Name of a God, he frankly confeſſed that his Subjection to Sleep and Women proved him but a Man; he might alſo have added,

ded, that, like other Men, he was neceſſitated to this Office of going to ſtool.

§. 108. The *groſſer Parts* [1] of the Aliment, which are ſo compact and ſolid, that they cannot be ſufficiently attenuated to enter the Lacteals, by the Action of Maſtication and Chylification in the Stomach and *Duodenum*; are yet more perfectly drained of their ſucculent and diſſolved Parts in the two other ſmall Inteſtines; which are for that End furniſh'd with a vermicular Contraction, numerous Valves, and various Convolutions, to the Length of about 37 Hands Breadth, being alſo lubricated internally by the *oily Mucus* [2] of their Glands: In the Capacity of theſe ſmall Inteſtines, the courſer Parts of the Aliment are therefore gradually propell'd forward, compreſſed, further divided, diluted, macerated, and their fluid Parts imbibed or drawn off by the Lacteals; while the *Remainder* [3] being deprived of almoſt all its Juices and more ſoluble Parts, is in that State *protruded* [4] thro' the End of the *Ileum*, which uſually opens almoſt perpendicularly into the left Part of the large Cavity in the *Cæcum* [5], by a narrow and oblong Aperture, furniſh'd with a ſort of Valves or folding Lips, and a Set of muſcular Fibres, that cloſe the Aperture, and prevent a Return of the Fæces, which are by that Valve directed into the ample Cavity of the *Inteſtinum Cæcum*.

[1] Such as cannot be ſufficiently attenuated and diſſolved into Particles ſmall enough to enter the Orifices

Orifices of the Lacteals, but are caſt out of the Body, after having endured the Action of the digeſtive Organs for ſome time, in the ſame manner as the hard Integuments and furfuracious Parts of farinaceous Seeds, which being deprived of their mealy and juicy Parts, remain ligneous and uſeleſs in Emulſions.

[2] Through the whole Tract of the ſmall Inteſtines there are a Number of ſmall Glands, ſituated in Cluſters, firſt obſerved by *Peyerus*, ſerving to ſeparate a gelatinous *Mucus*, partly oily, and partly aqueous, which is reſerved in Cells, from whence it is expreſſed very plentifully to the Fæces in their Paſſage. When this lubricating *Mucus* is wanting in lean and hypocondriack People, it occaſions cholicky Pains and Piles; to remedy which nothing is more ſerviceable than oily Glyſters; but there have been alſo Obſervations of the Fæces being ſo concreted and indurated in large Lumps, that they have entirely obſtructed the Cavity of the Inteſtine adhering to its Sides, and intercepting the Courſe of the Fæces.

[3] Theſe Fæces are the *Reſiduum* of all the Aliment ſeparated from its moſt fluid and milky Part, and from its alimental Juice, which is ſtill more ſubtle than Milk itſelf, and is that Fluid with which the *Fætus* is nouriſhed in the Womb of the Mother; for there is a conſiderable Quantity of Fæces found in the large Inteſtines of the *Fætus*, and in their *Appendicula Vermiformis*, which at the time of Birth are found full of Fæces, repreſenting the Juice of Poppies, uſually called *Meconium*. But theſe Parts of the Aliment which have been drained of their Juices in the ſmall Inteſtines, become altogether uſeleſs as ſoon as arrived into the larger Inteſtines; for the *Inteſtina Craſſa* are not furniſhed with a villous Coat, like the *Tenuia*, nor with exhaling Arteries, diſcharging a diluting Lymph; alſo the

Fæces

Fæces of a human Body are ſo light, as to ſwim upon Water when diſcharg'd out of the Body.

[4] It ſeems no eaſy Matter to explain by what Means the Fæces are propelled thro' ſo long a Tube as the Inteſtines, and to overcome ſo many Reſiſtances from the Valves, when the periſtaltic Motion moves them upwards as well as downwards; for it is certain when the periſtaltic Motion of the lower Inteſtines is retrograde, all their Contents are drove back, inſomuch that Glyſters have been ſeen to return into the Stomach. It may perhaps be anſwered, that the Inteſtines act more ſtrongly, as they are full, as their Action is weakeſt when they are empty; to which may be added, that the Fæces are collected not ſuddenly, and at once, but by degrees.

[5] Following the Ancients, we call that Part of the *Colon* the *Cæcum*; which is large and globular at its end or beginning, and ſo capacious, as at ſometimes to equal two Spans; and in this the Fæces are collected as they ſlip thro' the *Ilium*. We cannot agree with the modern Anatomiſt *Veſalius*, and others, that the *Appendicula Vermiformis* ſhou'd be called *Cæcum*, ſince that cannot be reckoned one of the large Inteſtines; but the *Inteſtinum Cæcum* is the Seat of flatulent Diſorders in hypocondriac People and pregnant Women, occaſioned from the Air diſtending the Sides of the Inteſtine; which Air is ſet at liberty by Putrifaction of the Matter, and exerts a conſiderable Force; this Air paſſing thro' the whole *Colon*, occaſions intolerable Pain, which is frequently attributed to the Spleen and Stomach, when they are not the leaſt in Fault. I have even ſeen an inſtance among Men who led ſedentary Lives, where the hard Fæces have been gradually accumulated to ſo large a Quantity in this Inteſtine, as to occaſion the Death of a conſiderable Perſon,

Perſon, whoſe *Cæcum* was found diſtended with hard Fæces to ſuch a degree, that upon opening him it appeared not leſſer than a Man's Head. For it is to be obſerved, that all the more fluid Parts of the Aliment are abſorbed in the ſmall Inteſtines, and the remaining dry Fæces adhere ſometimes like Glue to the Valve of the *Colon*, inſomuch that I have frequently perceived it by the Touch in Women big with Child; and from this Quarter proceeds many of the Diſorders of Artiſts and Men of Letters, whoſe Fæces are obſtructed from the inflected Poſture of ſitting ſtill after Meals.

§. 109. The Reſervoir or *Diverticulum* of the large *Cæcum*, is furniſhed with a ſmall vermicular Appendix, or little *Inteſtine* [1], and a *Valve* [2], deſcribed by *Tulpius*, together with Ligaments which cloſe the ſame, and prevent a Return of the Fæces into the *Ilium*; this Inteſtine aſcending *perpendicularly* [3] into the *Colon*, renders it impoſſible for the Fæces to return into the *Ilium*; but they ſtagnate, and are retained ſome time here, and are ſtrongly compreſſed, not only by their own Weight, but alſo by the Contraction of the Inteſtine and circumjacent Parts; by which means they are deprived of all their more fluid and aqueous Parts, which being abſorb'd by the *Lymphatics* [4], are conveyed to the *Receptaculum Chyli* and *Thoracic* Duct, till at length the Fæces are formed into hard, dry, figur'd, putrid, and fœtid Excrement, different from the Contents of *any* [5] of the other Inteſtines. The *Colon* is next, furniſh'd with numerous and large *Valves* [6], diſpoſed in three Ranks, formed and

ſupported by the Action of three muſcular Ligaments which contract the Capacity of the Inteſtine, and detach muſcular Fibres, to ſtrengthen its thin and membranous Structure, which wou'd be otherwiſe too weak to cauſe a perpendicular Aſcent of the Fæces; and being variouſly *inflected* 7, of a large Diameter, and about eight Hands Breadth long, is well adapted to collect, retain, and retard the Fæces, drain off their aqueous Parts, and *putrify* 8 the reſt. The ſtrong Fibres of its muſcular and membranous Coat being then irritated to *Contraction* 9 by the hard Fæces (which wou'd not paſs if the Tube was not diſtractile, and their Surfaces lubricated with an oily *Mucus* from the *Glands* 10) they are by that means protruded into the *Rectum*, in which the Fæces are gradually collected without our Knowledge, but are diſcharged indeed not without our Knowledge and Influence of the Mind, tho' they cannot be well retained by the Mind, when it is requiſite they ſhou'd be diſcharged, without exciting a *convulſive Motion* 11, and very uneaſy Senſation, which is a Circumſtance much conducing to the Well-being of the Animal.

7 This is a ſmall ſlender Proceſs of the *Cæcum*, ariſing uſually from its bottom or ſide, at ſome diſtance from the *Colon* in that Part which is oppoſite to the Inſertion of the *Ilium*; this Proceſs, or ſmall membranous Bag, is furniſh'd with glandular Cells, which diſcharge a *Mucus* to the Fæces. This Appendix is larger in the *Fætus*, which ſerves to increaſe the Space deſtin'd for the Reception of its *Meconium*,

Meconium, or Fæces, which at that time fills all the large Inteſtines; but the ſmall Inteſtines admit no Part of the Excrement: but when the Fæces are accumulated in thoſe Parts to ſuch a degree that they cannot be eaſily contain'd, by diſtending and irritating the Inteſtine, it occaſions Pain, and cauſes the Infant to ſtruggle, whereby the natural Birth is promoted.

[a] This Valve has been deſcribed by *Varolius* and *Bauhine*, but moſt exactly by *Tulpius*, it being formed by an Inſertion of the *Ilium* ſome way into the *Colon*, in the ſame manner as the *Duodenum* is inſerted within the *Pylorus*: the *Ilium* and *Colon* at their Juncture do not make a right Angle in the human Body, as they do in Brutes; but the *Ilium* hangs pendulous a little way within the *Colon*, and being as it were divided in the middle, forms the Valve of the *Colon*, the Aperture of which is ſtrengthened by an annular Series of muſcular Fibres. The Uſe of this Valve is, to admit the groſs and fœcal Parts of the Aliment out of the *Ilium* into the *Colon*, and to prevent their Return again by any Cauſe from the *Colon* into the *Ilium*; the Valve being folded together in ſuch a manner, and contracted by its muſcular Fibres, that nothing can paſs out of the large into the ſmall Inteſtines; as readily appears from the Laws of Hydraulics and the Structure of the Part. Sometimes this Valve is lacerated, and becomes paralytic and relaxed, by ſome Violence or convulſive Motion; in which Caſe the Fæces of the large Inteſtines are regurgitated even by the Mouth, which filthy and terrible Diſorder, is from its own Nature called *Miſerere mei*. Below the Inſertion of this Valve is ſituated the large Cavity of the *Inteſtinum cæcum*, in which the Fæces are convey'd and accumulated.

[a] This

[3] This perpendicular Aſcent of the *Colon*, and Incurvation thereof at the Liver, it being more inflected by the ſedentary Poſture of the Studious, occaſions the Fæces to ſtagnate, and be retained longer; and during the Putrifaction of the Fæces in this Cavity, they diſcharge a conſiderable Quantity of elaſtic Air, whence flatulent Diſorders, and the Symptoms familiar to hypochondriacal and ſtudious Perſons.

[4] *Malpighius* has obſerved theſe Lymphatics in the Cells or Appendices of the *Inteſtina Craſſa* in an Aſs, which he ſaw open into their Cavity, for the abſorbing a turbid or dirty Lymph; they are not indeed ſo eaſily perceived in the human Body, but that they are there, is apparent from the Inſtances we have of Men kept alive a conſiderable time barely by nouriſhing Glyſters; alſo from the Uſe of Glyſters made of Honey, Nitre and Water, in inflammatory Diſeaſes; which would hardly be of any Service, if there was not a Paſſage from the large Inteſtines into the Blood, no Part of the Liquor in the Glyſter being diſcharged again; which evidently demonſtrates an Abſorption of the ſame made by the Lymphatics: this Lymph is not indeed putrid, but is in a State tending to Putrifaction, and is of ſome Uſe to the Blood when it arrives there.

[5] The Fæces of the Inteſtines are not fœtid when in the *Ilium*, notwithſtanding they are pretty dry and exhauſted; but as ſoon as they have paſſed thro' the Valve of the *Colon*, they acquire a putrid and fœcal Stench, from ſtagnating ſo long in that Part, and from the fermenting Contents already in the Inteſtine, with which they are mixed; ſo that from their natural Tendence to Putrifaction, and become alcalious in a warm and moiſt Place, they muſt neceſſarily put on the fore-mentioned

Appearance. This Change being quickly made in the Fæces, occaſioned *Helmont* to imagine that it aroſe from a Ferment reſiding in the *Appendicula Vermiformis*, which converted the uſeleſs Parts of the Food by its Acrimony into Dung; but the fore-mentioned Cauſes ſeem altogether ſufficient, without any particular Ferment in this Part, which uſually contains nothing but a *Mucus*, diſcharged by many ſimple Glands; nor do the Fæces become putrid and fœtid all at once, for they are more ſo in the *Rectum* than in the *Colon*, and ſtill more ſo as they arrive nearer the *Anus*.

6 There are three ſtrong Ligaments detach'd from the *Appendicula Vermiformis* on each ſide, thro' the whole Length of the *Colon*, which contract that Inteſtine like ſo many Muſcles, and terminate in the *Rectum*; theſe Ligaments are at leaſt ſix times ſhorter than the *Colon* itſelf, ſo that upon ſeparating them from that Inteſtine, it becomes much elongated, thinner and narrower, its thickneſs being entirely owing to theſe Ligaments: the Uſe of theſe Ligaments is to elevate the *Rectum*, and contract the Length of the *Colon*, or approximate one end towards the other, by that means to contract it in length, and form it into Wrinkles or Cells, which do not conſiſt in a Corrugation of the villous Coat, which is not to be found in the large Inteſtines, but of the nervous Coat; which being ſeparated from its Ligaments, the *Colon* becomes four times as long as before: this is a ſurpriſing Contrivance, to render the Inteſtines capable of retarding the Fæces, without being of any great Length or large Diameter; for if the Paſſage of the Fæces had been direct and open, the Animal would have been continually diſturbed with the diſagreeable, but neceſſary Evacuation of this Part; the *Colon* is therefore formed of a middle Capacity,

Capacity, and repleniſhed with moveable Valves, ſo that it can dilate and make way for the larger Fæces, and contract itſelf to the ſmaller. Theſe Valves are very large in the Colons of Rabbits, Hares, Birds, and Horſes, in order to divide and give the Fæces a globular Figure; but there are not any to be found in the *Rectum*. Another Uſe of theſe Valves is, to ſuſtain the Weight of the Fæces, and to facilitate their Aſcent in the *Colon*.

[7] The various Inflection of the *Colon* in the human Body, accurately deſcribed by *Veſalius*, is very different from that in Brutes; for the *Colon* firſt aſcends from its Origin at the right *Ilium* up to the Liver and *Duodenum*, where it is inflected acroſs at right Angles under the Stomach towards the Spleen; where being again inflected, it forms a Dilatation, which receives the *Flatus* in hypochondriacal People, and the Fæces of Women with Child; from thence it deſcends in a right Angle down to the left *Ilium*, where aſcending a little obliquely towards the right Side, it makes its laſt Inflection, and forms the *Rectum*, deſcending upon the *Os ſacrum*. Hence we obſerve, that the Fæces are twice obliged to aſcend perpendicularly, paſſing over the Reſiſtance of four Angles, two right, and two acute. In that Curvature of the *Colon*, form'd by its tranſverſe Progreſs from the Right to the Left Side, and deſcending near the Spleen, is the Seat of thoſe Pains in the Studious and Sedentary; which are often improperly attributed to the Spleen, ſince they proceed from the confin'd *Flatus* diſtending the Inteſtine, which is in the Angle obſtructed by the indurated and accumulated Fæces: which ſame Diſorder alſo occurs in Women with Child, when the diſtended *Uterus* occupies almoſt the whole Capacity of the *Abdomen*. That the Spleen is not the Seat of theſe

Complaints, appears from their Removal by a laxative Medicine, which cannot be ſuppoſed capable of extending its Effects to that *Viſcus*.

[8] All the recent Parts of Animals and Vegetables, when confined in a cloſe and warm Place, putrify and degenerate into a ſtinking Excrement: and as this is the Caſe in the Inteſtines, we find they undergo the like Changes there; the more readily, as the Excrements are charged with animal Humours, eſpecially the Bile, which is of an alcaleſcent Nature, and tends greatly to Putrifaction; therefore human Excrements afford a volatile alcaline Salt by Diſtillation, even tho' the Perſon was fed only upon acid Food. It is alſo obſervable the inteſtinal Fæces afford *Phoſphorus* in the greateſt plenty.

[9] This Motion of the large Inteſtines is different from the periſtaltic Motion of the ſmall Inteſtines, by which the latter are kept in conſtant and ſucceſſive Agitations or Contractions; for the Contraction of the large Inteſtines is muſcular, and perform'd only when the Fæces are preſent, ſtimulating by their Quantity and Acrimony, and ceaſing again when the Inteſtines are not irritated by their Fæces.

[10] Theſe are large ſolitary Glands, which diſcharge their *Mucus* by large Ducts into the Cavity of the Inteſtines.

[11] There are Nerves extreamly ſenſible diſtributed to the laſt of the large Inteſtines, which renders the Preſſure and Retention of the hard Fæces ſo intolerable, as to occaſion that uneaſy Senſation or Motion to Stool, which is not properly a Pain, but a ſort of Convulſion of all the Muſcles conſpiring to expel the offending Matter with ſo much Impetuoſity, that the Fæces are frequently incapable of being retain'd behind the *Rectum*, notwithſtanding

withſtanding all the Influence of the Mind to prevent their Excluſion. Related to this Motion, is the Throws of the Mother in Labour, who is no ſooner ſeized by her Labour Pains, than a violent *Teneſmus* follows, with a Protruſion of the Head of the Infant to the Mouth of the *Uterus*, in ſuch manner, that the Mother is rather tortured with an intolerable *Conatus* than real Pains. A like *Conatus* or *Teneſmus* is alſo obſerved amongſt the Inhabitants of the *Indies*, who are fatigued with ſuch an uneaſy Senſation from a Vellication of the Nerves in the *Rectum* and *Anus* by ſharp Humours, as to oblige them to be conſtantly going to Stool, without Effect, where-ever they are going, till they at laſt periſh in great Miſery with a Convulſion of all the Extremities.

§. 110. The Fæces are then forced into the *Rectum*, which deſcends almoſt perpendicularly thro' the *Pelvis*, and being well lubricated on its internal Surface, without any Valves, and without any muſcular Ligament, by that means the Fæces meet with a more eaſy Deſcent, whilſt they irritate its muſcular Fibres to contract by their Weight and Acrimony, or both. The muſcular Coat of this Inteſtine conſiſts of ſtrong *longitudinal* Fibres, ariſing from an Expanſion of the Ligaments of the *Colon* meeting together, inveſt all the whole external Part of the *Rectum*, and joining the Extremity of the *Colon* and *Rectum* to each other, they alſo contract the Length and Diameter of the latter; to do which they are alſo aſſiſted by *ſpiral*[2] or circular Fibres, whereby the Fæces are driven down even to the *Sphincter*, ſtop-

ping at the fleſhy Columns and *Valves*[3] at the End of this laſt Inteſtine.

[1] When the three Ligaments of the *Colon* have reached the *Rectum*, they become expanded, and diſtribute their Fibres equally over that Inteſtine, without contracting it into Valves: Theſe elevate and ſuſtain the *Rectum* ſo ſtrongly, that if it ever ſuffers a *Prolapſus*, it is always by way of Inverſion.

[2] Theſe longitudinal and ſpiral Fibres aſſiſt each other in their Action; the longitudinal Fibres draw the Inteſtine backward over the Fæces, and elevate it after they are diſcharged, to prevent a *Prolapſus Ani*, while the ſpiral Fibres do by this Contraction protrude the Fæces forward. It is alſo obſervable, that this Motion of expelling the Fæces, is never retrograde or reverted, as that of the ſmall Inteſtines frequently is.

[3] Theſe ſimple and compound Valves at the Extremity of the *Anus*, have been accurately deſcribed by *Morgagni* in his *Adverſaria Anatomica* III. *Fig.* I.

§. 111. Then the large, thick, fleſhy, and orbicular or oval *ſphincter*[1] Muſcle of the *Anus*, embracing the End of the *Rectum*, being *relaxed*[2], the elevating Muſcles are next contracted, whoſe Fibres are inſerted under the former, ariſe from the inſide of the *Os Pubis*, *Iſchium* and *Sacrum*, conſiſting of many ſtrong converging Fibres, which being inſerted under the *Sphincter*, are extended to the very End of the *Anus*, which they dilate and elevate; by which means the Fæces are more expoſed to the

the Preſſure of the *Peritonæum* and circumjacent Parts above the *Pelvis*; then the *Pelvis* being ſtrictly compreſſed by the Air inſpired, retained, and rarefied in the *Thorax*, together with the Contraction of the *Diaphragm* and abdominal Muſcles, the Fæces meet with a ready Deſcent thro' the *Rectum*, whoſe Sides are plentifully lubricated with a ſoft *Mucus* 3, preſſed out from its numerous Cells and ſmall Glands by the Fæces; which being now excluded, all the preceding are relaxed, and the *ſphincter* Muſcle alone is ſtrongly contracted. The large Quantity of *Fat* 4 which inveſts this Inteſtine on every Side, with the ample circumambient Space fill'd with nothing but ſoft Fat, render it very well adapted to receive and retain the Fæces to be expell'd.

1 It has been controverted amongſt Anatomiſts, how it cou'd be poſſible that the *Sphincter* ſhou'd retain the Fæces, ſince *Bernoulli* has demonſtrated that an annular or circular Muſcle cannot be contracted above one third Part of its Diameter; but the *Sphincter*-Muſcle of the *Anus* is not a Line without Breadth; but being contracted, it forms its large internal Membrane into *Rugæ*, which protruding into the Cavity of the Inteſtine, fills up its Space, and prevents any thing from eſcaping. Anatomiſts are uſed to deſcribe the *Elevatories Ani*, as ariſing from each Side of the *Anus*, and terminating in the Margin or Extremity of the *Rectum*; which is falſe, for they ariſe before from the *Os Pubis*, and behind from the *Os Sacrum*; alſo on each Side from the *Oſſa Illia*; from whence deſcending, their muſcular Fibres inveſt the whole Surface of the

Rectum; ſo that they not only elevate, but alſo ſtrongly dilate the ſame; which has juſtly been obſerved by *Bidlow*, *Cowper*, and *Santorini*.

[2] The *Sphincter*-Muſcle of the *Anus* is not relaxed by the Will; I even much doubt whether the Mind has a conſiderable Influence upon any of the *Sphincters*; it is relaxed or opened, by becoming Paralytic, from the Preſſure of the Fæces; ſo that being deprived of its Influx of the nervous Fluid, it cannot exert its wonted Reſiſtance, eſpecially as the *Diaphragm* preſſes down all the *Viſcera* of the *Abdomen* with a conſiderable Force, which at laſt terminates or acts only upon the *Sphincter*. The Force of the retained Air in Inſpiration ought alſo to be allowed a Share, with the forcible Depreſſure of the *Diaphragm*, in expelling the Fæces, which always ceaſe to be diſcharged upon Expiration; ſo that as the *Fœtus* does not reſpire, it alſo does not diſcharge its Fæces by the *Anus*, whilſt incloſed in the *Uterus*; and if it diſcharge any Fæces thro' the *Uterus* in the Birth, we may be certain it has breathed, and that if it be not inſtantly delivered, it will not long ſurvive; in this Action therefore the Air, which is taken in with a ſtrong and deep Inſpiration, is retained and rarefied in the Lungs; the *Glottis* being cloſed, and its Expiration prevented, whilſt it acts upon the deſcending *Diaphragm*, which preſſed down the Stomach, Liver, and all the Inteſtines upon the *Pelvis*, which being furniſhed with no antagoniſing Muſcles, receives the Force of all the other Parts of the *Abdomen*, whereby the Urine and Fæces are expelled with a conſiderable Force.

[3] There are in this Part abundance of very large mucous Ducts, or *Lacunæ*, into which a *Fiſtula* of the *Anus* often inſinuates, and becomes very obſtinate, conſuming all the Fat of this Inteſtine, inſo-

much

much that its Sides become inflamed and ulcerated, by rubbing againſt each other, without any Lubrication; but the *Sphincter* itſelf is ſeldom corroded, except in the Venereal Diſeaſe. If this *Mucus* is wanting, as it frequently is in Infants, the Child is in danger of periſhing, if an oily Glyſter be not injected, to lubricate the Excrement, which is then indurated and dried like Chalk. Alſo in the blind Piles the acute Pain may be prevented by injecting half an Ounce of Oil before going to Stool, which Experiment has never miſcarried in all the Patients who have had the ſame adminiſtred by my Advice.

[4] The *Inteſtinum Rectum* is very fat, inſomuch that it is vulgarly called by Butchers the fat Gut, which is even ſo in emaciated Subjects; beſides which it is alſo furniſhed with numerous mucous Glands, whoſe Contents are preſſed out by the Contraction of the longitudinal Fibres, which ſhorten the Inteſtine.

§. 112. From hence appears what Materials compoſe the Fæces; and whether they do not conſiſt in Part of the uſeleſs Superfluities of the *Bile* [1], *Blood* [2], *Mucus*, *Saliva*, Lymph, and pancreatic Juice; the *Cauſe* [3] of their Formation into Excrement; and whether it be from a Stercoracious *Ferment* [4], or Part of the Fæces before retained; why the Inteſtines are more copiouſly repleniſh'd with ſmall *Glands* [5] and *Mucus*, as they are nearer their Extremity; of what Uſe is the *Appendiculæ Adipoſæ* [6] of the *Colon* and *Rectum*; why ſtrong People are *coſtive* [7], and their Fæces few, light, and indurated; and why ſuch are frequently ſubject

ject to the *Piles*[8]; why expelling the Fæces alſo diſcharges the *Urine*[9]; why thoſe who have a *Stone*[10] in their Bladder are troubled with a *Teneſmus*; why People who have Dyſenteries are ſo frequently troubled with the *Strangury*[11]; and why a Strangury is often accompanied with a *Teneſumus*[12]; and laſtly, why the *Rectum* is ſuſpended *freely*[13], without being connected to any Bone or Muſcle in a large Cavity, filled only with Fat.

[1] *Helmont* ſtrenuouſly denies that any Part of the Bile is diſcharged with the Fæces, or tinges them; but their yellow Colour is a ſufficient Proof of the Bile being preſent, as it is a common Obſervation, that the ſtronger the Bile, the deeper yellow is the Fæces; and the weaker the Bile, the paler are the Fæces; ſo that in the Jaundice they are often whitiſh, or Aſh-colour'd.

[2] There are many Arguments to prove that the Blood itſelf diſcharges its excrementitious Parts by the Inteſtines. As, (1.) The lax Structure of the meſenteric Veſſels, tranſmitting the ceraceous Injection into the Cavity of the Inteſtines. (2.) Their frequent Inoſculations with each other; ſo that by injecting one Trunk, all the reſt are diſtended. (3.) The *Meconium* in the *Fœtus*, which ſeems to be rather formed from the Blood than the Liquor of the *Amnios*, which has been attenuated by the Action of ſo many Veſſels, and is much more ſubtil than the Blood itſelf; tho' the *Meconium* abounds ſo as to fill all the large Inteſtines, and is ſo feculent as to reſemble *Opium*. Alſo, (4.) The Depuration of the Blood by the Inteſtines, which is ſo ſtrongly promoted by the Exhibition of briſk Purges, which excite frequent and copious Diſcharges.

charges. There are alſo other Reaſons to prove that the Liver, Spleen, and whole Maſs of Blood, may be freed from their noxious Parts by the Inteſtines; which was the Opinion of the Ancients. We are alſo furniſh'd with another Argument from ſad Experience; for ſince the Invention of the triangular Dagger, called a Bayonet, there have been frequent Inſtances of Wounds dividing the Inteſtines; in the Cure of which, nothing was more neceſſary than ſupplying the Patient with Aliment affording little or no Fæces, till within the Space of fourteen Days the Inteſtines were again united; this was performed by feeding the Patients with Broth only, by which means there were no Fæces diſcharged for the Space of 14 or 21 Days; at the end of which time, when the Excrements were voided, they appeared like *Meconium*, proceeding chiefly from the animal Humours diſcharged into the Inteſtines.

[3] By draining the Aliment of all ſuch Parts as are aceſſent and nutritious, the Remainder being conſtantly ſupplied with animal Juices, tending to Putrifaction with the addition of Heat and Reſt; whence it follows, from their own Nature and ſpontaneous Changes, that they become putrid and excrementitious.

[4] According to the conſtant Obſervation of *Helmont*, who could never find fœtid Excrement in the *Ilium*, nor any Contents of the *Colon* which were not fœtid; he therefore ſought for the Cauſe of this Change in the Confines of the *Ilium* and *Colon*; and as he was previouſly biaſs'd with the Notion of Fermentation, he ſuppoſed a yellow Ferment in the *Cæcum* which putrified the Fæces; and returning to the Kidneys, tinged the Urine of a yellow Colour; which, he ſays, *Galen* wrongly attributes to the Bile. But that Gentleman ſeems either never

ver to have read the Writings of *Harvey*, or elſe he peruſed them when he was too old to change his Opinion; but he might have known that all Vegetables, even the moſt acid, putrify only by ſtagnating in a cloſe, warm, and moiſt Place.

[5] Becauſe the Fæces are drier, harder, and more acrimonious, as they approach nearer to the Extremity of the Inteſtines.

[6] The cellular Coat is more conſpicuous in the large than ſmall Inteſtines, and is more plentifully ſupplied with Oil between their external and muſcular Coat; but the *Omentum* is wanting to theſe Inteſtines, and their muſcular Fibres require more Lubrication; without which their nervous Coat would be injur'd by the Attrition of the hard Fæces, not without danger of Inflammation or Excoriation; we therefore meet with a Portion of Fat about the *Anus* near an Inch thick, which being diſſolved by Heat, tranſudes into the Cavity of the Inteſtine, to lubricate its internal Surface with the Fæces, that their Attrition might not produce Pain, Inflammation, or Ulcer; and accordingly we obſerve that fat People are ſeldom troubled with the Piles, but lean Perſons very often.

[7] It is a commonly receiv'd Opinion, that it is more healthy to be looſe than coſtive; and many being prejudiced with that Notion, are continually irritating their Bowels with cathartic and laxative Medicines, by which means they become inſenſible and ſluggiſh to the natural and weaker *Stimulus* of the Bile; but it is certain, contrary to this Opinion, that the digeſtive Organs are always ſtronger, in proportion as the Fæces are harder, lighter, and more figur'd; for that is a certain Token that all their uſeful Juices have been abſorbed by the Lacteals. Nor is there any room to ſuſpect Danger from a Conſtipation of the Bowels

els for the Space of ſix, or even twelve Days, if the *Abdomen* appears ſoft, and not tumified, and the Appetite ſtrong in the mean time; whereas a fluid State of the Fæces denotes, and is a cauſe of Weakneſs; it ſignifies that the Aliment has been acted upon by a Force too weak in the digeſtive Organs, whence a great Part of the Chyle is loſt, and diſcharged with the Fæces; but the hard and dry Fæces are lighter than ſoft and fluid, becauſe the Bread, *&c.* of which they are compoſed, are lighter than Water; but the Fæces of People in a Dyſentery ſink to the bottom of Water; dry Fæces, without a Tumour of the *Abdomen*, are therefore healthy, and ſignify that the Aliment is perfectly digeſted or attenuated, affording a large Quantity of Chyle to ſupply the Blood and all the other Juices, affording very few Fæces. To this Place belongs the Obſervation of *Sanctorius*, that Perſpiration being increaſed, the other Excretions are diminiſhed; and the contrary.

[8] This Propoſition, notwithſtanding its Truth, ſeems to be a Paradox. We find that Women have a ſalutary Diſcharge of Blood from their *Uterus* every Month, which frees them from a *Plethora*, and prevents many conſequent Diſorders; in like manner there is no reaſon why a ſimilar Diſcharge of ſuperfluous Blood in Men ſhould not be equally ſerviceable. The *Italians*, *Spaniards*, and *Dutch*, congratulate their Friends upon the Acceſſion of a large hæmorrhoidal Flux in Diſorders; and when the hæmorrhoidal Diſcharge is either diminiſhed, or wholly ſuppreſſed, violent Head-achs, and many other Diſorders follow. Alſo if bleeding at the Noſe is uſeful to a plethoric young Man, why may not the like Diſcharge in the Piles prove of the ſame Uſe? Our next Buſineſs is to explain why healthy and ſtrong People,

who

who are usually costive, are more subject to the Piles than others; in them the hard and globular figur'd Fæces filling the whole Cavity of the Intestine, cannot be discharg'd without violent straining; so that by the strong Pressure of the Diaphragm and abdominal Muscles upon the *Rectum* to discharge its Fæces, the Veins distributed upon the Surface of that Intestine are strongly compressed, and their Blood stopt in its Passage; so that being still drove forward by their Artery into them, they are more distended with Blood; and being almost destitute of Elasticity, they remain dilated even after the Pressure ceases, which occasions varicose Tumours or Knots, continuing distended with thick Blood; which upon a Repetition of the former Pressure burst, and discharge a Quantity of thick and dark-colour'd Blood, which is called the open Piles; but while the varicose Tumours remain entire, they are call'd the dry or blind Piles. If the Coats of the Veins were thick and strong, the Piles remain blind, or dry, with great Pain; but if they were thin and weak, they break easily. Men of Letters are frequently subject to this Disorder from a Constipation of their Bowels; whence arises Pain and many bad Symptoms, in those Persons whose Nerves are easily disorder'd from the smallest Causes of any other kind; these will find the most Benefit by injecting an Ounce of Oil into the *Anus* before they go to stool, ordering them to abstain from warm, dry, and astringent Food, and to eat frequently of Garden Fruits. Women are seldom disorder'd with the Piles, except when they are near Lying-in, when the *Uterus*, which is then greatly distended, compresses the hæmorrhoidal Veins.

' Because the same Force of the *Diaphragm* and abdominal Muscles which discharge the Fæces, will

will alſo compreſs the Bladder; but the ſame Force which diſcharges the Urine, will not alſo expel the Fæces; becauſe the Bladder may be emptied by a leſs Preſſure than what is required to overcome the Reſiſtance of the *Sphincter Ani*. It is alſo obſervable, that ſome of the Fibres of the *Elevatores Ani* inveſt Part of the *Urethra*, and proſtrate; whence it frequently happens, that the *Mucus* of thoſe Parts is frequently preſſed out at the ſame time when the Fæces are diſcharged; which is a Caſe occurring in the moſt healthy Men, without any Cauſe of a *Gonorrhœa*, which is frequently ſuſpected by Phyſicians.

[10] Becauſe the Neck of the Bladder is incumbent upon the *Rectum*, by which means the Reſiſtance of a Stone ſtimulates the *Rectum*, the ſame as hard Fæces.

[11] From a ſharp Matter lodg'd in the Interſtices of the *Anus*, which corroding the *Rectum*, puts it into a convulſive Motion, which by Continuity of Parts is communicated to the Bladder, whence a Strangury is frequently met with in Dyſenteries; but a Strangury is alſo ſometimes occaſioned by hard Fæces ſtopping in the *Rectum*, and preſſing upon the Neck of the Bladder, which irritates it in the ſame manner as a Stone.

[12] The Bladder contracting itſelf with a great Force to diſcharge its Contents, is formed into a globular Figure; and being incumbent upon the *Anus*, gives the Senſation of hard Fæces; beſides which the Bladder is alſo irritated and ſollicited to diſcharge its Contents by the Acrimony of the Urine, as we have ſometimes obſerv'd from drinking new Ale; which Irritation is communicated by a Conſent of Parts to the *Rectum*, which is nearly attach'd to the Neck of the Bladder and *Urethra*.

[13] The

[13] The generality of the ſofter Parts of the human Body are conſtantly attach'd or fix'd to ſome Bone, only the *Uterus* and *Rectum* are at liberty on every ſide; which was neceſſary, that they might be equally and largely dilated. When a Perſon has been conſtipated for the Space of above ſix Days, the hard Fæces are ſometimes ſo compacted together in the *Rectum*, that they dilate it like a Ball, and prevent the Paſſage of any Glyſter; in which Caſe the hard Fæces are to be taken out with an Inſtrument, and afterwards a Glyſter injected.

Concerning the Action of the Meſentery on the Chyle.

§. 113. THE Chyle (§. 105.) being impelled into the open Mouths of the *Lacteals*[1] (§. 103.) by the periſtaltic Motion (§. 103, 104.) is by the ſame Motion and Preſſure of the abdominal Muſcles and *Diaphragm* impelled forward towards its Receptacle. But ſince we are taught by many Experiments, that the Lacteals open *obliquely*[2] into the Cavity of the Inteſtines, their Mouths being extremely ſmall, we are aſſured that only the more white and *fluid*[3] Part of the Chyle, ſeparated from the more groſs, *ramous*[4], fibrous, and yellow, or aſh-coloured Part, enters by their Orifices, which paſs immediately thro' the muſcular Coat of the Inteſtines, and terminating in *larger*[5]

larger 5 Veſſels under the external Coat of the Inteſtines, proceed towards the *Meſentery* 6.

[1] As ſoon as a Particle of the Chyle has enter'd an Orifice of the Lacteals, it meets with a Valve which ſeparates it from the Inteſtine, and prevents it from returning back; the Chyle is alſo drawn in by means of theſe Valves, as if it were in a ſort of *Vacuum*.

[2] That the Lacteals have an oblique Inſertion into the Inteſtines, is evident; becauſe neither Water nor Wind can be forc'd out of the Inteſtines into them; and becauſe their Orifices and firſt Progreſs cannot be ſeen even with a Microſcope. From this Obliquity of their Inſertion it happens, that the Inteſtines being diſtended, tranſmit nothing into the lacteal Veſſels; but when the Inteſtines are contracted and render'd ſhorter, that Part of the Chyle intercepted by the *Rugæ* of their villous Coat, is compreſſed; and at the ſame time the muſcular Fibres being contracted, the Chyle is retained in the *Villi* of their internal Coat; in the next Inſtant, when the muſcular Fibres are relaxed, the Chyle in the Lacteals which paſs thro' the muſcular Coat, runs toward their cellular Coat; and thus by the ſucceſſive Contraction and Preſſure of the muſcular Coat of the Inteſtines upon the Origin of the Lacteals, one Part of the Chyle drives the other forward towards the Meſentery.

[3] A great Part of the Food with which we are nouriſhed being converted into Chyle, is form'd into Globules, which are yet much leſs than thoſe of the Blood; theſe Globules have been obſerved by *Lewenhoeck* in Wine, Ale, and Dough: ſpherical Particles can more eaſily enter the cylindrical Orifices of the Lacteals, as they are of a leſs Diameter, and more compacted by the Power of the

digeſtive Organs, the Parts of the Chyle becoming leſs porous or more denſe by Attenuation; and their white Colour, joined with their ſmooth Surface, is a Mark of Denſity.

[4] Thus it is manifeſt, that a Feather or Piece of Wool ſwimming in a Fluid, will never paſs thro' a narrow Aperture; but only ſuch Subſtances as are more denſe, or contained under a leſs Surface, will make their way into and through ſmall Orifices.

[5] Immediately above the Inteſtines, and ſometimes even in their cellular Coat, there are Lacteals viſible to the naked Eye, and large enough to admit a Probe, as *Ruyſch* informs us, and *Nuck* has delineated.

[6] It is not every Anatomiſt that gives us a true Idea of the Structure of the Meſentery. The *Peritonæum* inveſting all the *Viſcera* of the *Abdomen*, alſo covers the *Aorta*, *Vena Cava*, and Nerves. When the Veſſels ſtrike off from the Loins, they do not perforate, but are intercepted in a Reduplication of the *Peritonæum*; theſe Veſſels are the ſuperior and inferior meſenteric Arteries, with the Receptacle of the Chyle, and correſponding Veins leading to the *Cava*. This Reduplication of the *Peritonæum* alſo intercepts and ſuſtains the lacteal Veſſels and Branches of the *Vena Porta*.

§. 114. Hence it appears, why a great variety of acrimonious, hard, and ſharp Subſtances, which are ſwallowed, prove *inoffenſive* [1] to human Bodies, and no ways detrimental to their Health; and if we compare the *Structure* [2] of the *Oeſophagus*, Stomach, and Inteſtines, with that of the other *Viſcera*, they will appear very different: As for inſtance, the Largeneſs

neſs or Diſproportion of the Cavity of the Inteſtines with the *narrow* [3] Orifices of the Lacteals which thence ariſe; to which we may add the Aptneſs of the ſmall *Sphincters* [4] at the Mouths of the Lacteals, to be contracted by acrimonious Particles, which guards them from a too eaſy Admiſſion of ſuch Humours.

[1] Thus we feed on almoſt all Sorts of Subſtances; but were many of them to enter the Blood, they would become Poiſons; ſome Parts of the Chyle are acrimonious, hard and viſcid, others oily, and rancid, and yet we receive no Injury from either.

[2] Their Compoſition being of tough and ſtrong Membranes, which ſtrongly reſiſt the Action and Injuries of other Bodies, inſomuch that boiling the Inteſtines for the Space of ten Hours does not diſſolve them; nor are they digeſted after they have undergone the Actions of the Teeth and Stomach of a voracious Dog. The internal Coat of the Inteſtines of Sheep, *&c.* remain tough and whole, after they have been boiled long enough to render the minc'd Meat within them ſoft and tender; as in *Bologna*-Puddings, Sauſſages, *&c.* There is a great difference between the tough Conſiſtence of the Inteſtines when formed into Cat-gut or elaſtic Fiddle-ſtrings, and the ſoft Subſtance of the Liver, which crumbles between one's Fingers.

[3] Which only tranſmit ſuch Parts of the Aliment as have before been form'd into Globules, of a determinate Size, by the digeſtive Organs; all Particles of any other Figure, coming obliquely upon the Mouths of the Lacteals, being excluded; and if they are acrimonious, they ſtimulate their membranous Mouths or Sphincters to Contraction.

[1] There are a vaſt Number of Nerves, and thoſe extremely ſenſible, diſtributed to the Inteſtines, which are eaſily vellicated by any thing acrimonious; theſe contract the whole Capacity of the Inteſtines, as well as the ſmall Orifices of the Lacteals, whereby they refuſe Admittance to acrimonious and injurious Subſtances; which Office is by *Helmont* attributed to his *Archæus*. By the ſame Contraction they alſo preſs out a Lymph from the ultimate Branches of the meſenteric Arteries, to mollify and dilute the acrimonious Food. If a Grain of Salt ſlips into the Lungs, it occaſions inceſſant coughing; if any thing alike. acrimonious ſhould penetrate to the Brain, it will there occaſion ſurpriſing Commotions. We ſee that Wine affects the Tongue with a pleaſant Acidity, but if a little of it falls into the Eyes, it produces great Irritation till it is waſh'd out by the Flux of Tears. The whole Surface of the Skin is alſo corrugated or contracted into numerous ſmall Tubercles by the Action of injurious Cold, whereby the Orifices or Sphincters of the Pores are contracted, the Air excluded, and their contained Fluids, which would have been diſcharged in a warm Air, are thus retained. So it is alſo in the Inteſtines, Poiſons do not enter the lacteal Veſſels; but being mix'd with the Chyle, are excluded by their Sphincters, being afterwards diſcharged by the convulſive Irritation which they excite.

§. 115. The ſeveral Cauſes which impel the Chyle into the Lacteals (§. 113.) ſtill continue to *protrude*[1] freſh Chyle, and preſs forward what was before received, by which means the Chyle is forced thro' the Lacteals, ſeated in the cellular Subſtance of *Ruyſch*, between the *Duplicature*

plicature [2] of the *Meſentry*, where it is detained from flowing back again by ſemilunar Valves fix'd by *Pairs* [3] in the Lacteals, and its Courſe determined towards the Loins.

[1] The lacteal Veſſels paſs through the muſcular Coat of the Inteſtines, and creep along the cellular Coat, without perforating the external; ſo that having reach'd the cellular Subſtance of the Meſentery, they are by that defended and lubricated in their Courſe.

[2] The Force which firſt impell'd the Chyle into the Lacteals, ſeems to ceaſe where thoſe Veſſels perforate the muſcular Coat of the Inteſtines, where it is protruded forward by ſucceſſive Supplies of ſucceeding new Chyle, whilſt its Return is prevented by their Valves.

[3] Theſe Valves ſuſtain the Weight of the Chyle in its Aſcent, and prevent it from returning back the way it came; they appear to be ſo numerous and ſtrong, that *Mercury* being injected by the Lacteals, could never break thro' their Reſiſtance, ſo as to paſs into the Cavity of the Inteſtines; nor can Air be forced thro' thoſe Veſſels into the Inteſtines by inflating the thoracic Duct and Lacteals, *&c.* Theſe Valves alſo prevent the preceding Chyle from obſtructing the Progreſs of that which follows; ſo that the Chyle meets with leſs Reſiſtance in its Progreſs, proportionable to the Number of Valves; and the Space between the two preceding Valves being emptied, makes a ſort of *Vacuum*, into which the ſucceeding Chyle flows without any Reſiſtance; and in this reſpect they ſeem not to differ from thoſe in the Lymphatics which were demonſtrated by *Ruyſch* in his younger Days; notwithſtanding his Antagoniſt *Bilſius*, who being not

ſkill'd in Phyſic, tho' well verſed in living Diſſections, maintain'd that the lacteal Veſſels had no Valves, and that *Flatus* might be eaſily drove thro' them into the Inteſtines from the Receptacle; but *Ruyſch* ty'd a lacteal Veſſel of a Horſe lately kill'd in two places, and inſerted a ſmall Steel Tube, made by our Countryman *Muſſchenbroeck*, and inflating it with Air, dry'd and inverted it, and demonſtrated double Valves.

§. 116. The Lacteals in a human Meſentery being extremely minute at their Origin, unite and meet together in acute Angles, forming *larger* [1] Veſſels; which Veſſels afterwards recede from each other, and forming a Sort of Iſlands, they meet together again, and uniting in their Progreſs, they form ſtill larger Veſſels; all which are furniſhed with many diſtinct Valves. In theſe Veſſels, call'd Lacteals of the firſt Order, the Chyle is more perfectly mixed, *attenuated* [2], and rendered more fluid.

[1] Hence the intimate Mixture, Uniformity, and Attenuation of the Chyle in theſe Veſſels; for if different Juices, conveyed by ſeparate Canals, at laſt return into one Veſſel, they will undergo an intimate Mixture: but this Communication of the lacteal Veſſels with each other is often repeated, by which means their Mixture is render'd ſtill more uniform; which it would not be if the Veſſels ran parallel, or had but one Communication with each other: thus if two Veſſels, conveying different Fluids, communicate with each other but in one part only, the Liquors will flow out of their containing Tubes diſtinct in their Direction and Colours,

lours, the Red by itſelf, and alſo the Blue; or they will be but half mixed, half of the blue Liquor flowing thro' the red Veſſel, and half of the red thro' the blue: but if the Tubes frequently unite, ſeparate, and again communicate, the Liquor will be of one Colour in both of them. In the ſame manner the Chyle, which comes feculent from the large Inteſtines, meets and mixes with the more mild and ſubtil Chyle of the ſmall Inteſtines, ſo as to form one ſimilar milky Fluid.

[2] If a Liquor be moved with a very great Velocity, its Parts will not be divided or attenuated without the Reſiſtance of ſome Solids, upon which the Parts of the Liquor may impinge, and be divided from each other; and this is admirably well effected by the Angles of the Veſſels: for if one Veſſel be divided into two Branches, its contained Liquor will ſtrike upon the Angle of its Diviſion, and be thereby attenuated; and thus the Chyle is prevented from congealing or running into Grumes by its ſlow motion thro' the Lacteals: by increaſing the Contact of Particles, they attract and adhere to each other more ſtrongly, and thence loſe their Motion; but if their Contact be perpetually changed, and the Particles ſeparated, they will not concrete together.

§. 117. The Lacteals being thus diſtributed thro' the Meſentery, ſome in right Lines, others in oblique ones, variouſly interſecting and inoſculating with each other, proceed to the very ſoft and ſcattered *Glands*[1] diſperſed thro' the middle of the Meſentery; and meeting together in theſe Glands, which they *penetrate*[2] and *inveſt*[3], they paſs out again from them in larger and leſs numerous Branches,

diſtended with the Chyle, now render'd more fluid and diluted. Theſe Lacteals, which convey the Chyle to the Receptacle at the Loins, are alſo furniſh'd with many diſtinct Valves, and are denominated Lacteals of the ſecond Order.

[1] *Euſtachius* was the firſt that deſcribed theſe Glands, which he did ſo well, that *Ruyſch* with his Injection, and the other minute Anatomiſts, could make but little Improvement therein; they are uſually diſtributed in the human Meſentery, without obſerving any conſtant or regular Order, only they uſually adhere to the Sides of the Blood Veſſels at their Ramifications, as *Euſtachius* has accurately expreſſed in his Figure of them. Theſe Glands gradually ſhrink and diſappear in old People, inſomuch that I and my Friend *Ruyſch* could ſcarce perceive any Remains of them in the Meſentery of an old Woman which he injected. And the ſame has been alſo obſerved by *Ruyſch*, not only in the Glands of the Meſentery, but alſo in the Glands of the Breaſts, *Thymus*, *&c.* but without any evident Cauſe. The Glands of the Meſentery are ſo ſoft, that they may be ſqueez'd to pieces by the Fingers. In the generality of Brutes theſe Glands are not diſperſed thro' the Meſentery as in the human Body, but collected into one large Gland, which being fixed in the Center of the Meſentery, adheres to the Loins, and was by *Aſellius* called *Pancreas*, from its Similitude to that Gland; and other ſucceeding Anatomiſts alſo adding the Name of its firſt Deſcriber, have called it *Pancreas Aſellii*. So that Brutes have but one Order of Lacteals, the Structure of the other Parts of their Meſentery being different from that of the human.

[2] This

[2] This is demonſtrated by the remarkable Obſervation of *Nuck*, made in the Body of a Clown, who being kill'd at a public Feaſting, was publicly opened by Order of the Magiſtrates, to diſcover the nature of his Wound. In this Subject the *Mercury* which was injected into the Lacteals of the firſt Order, penetrated the meſenteric Glands, and fill'd ſeveral of their Veſſels, paſſing afterwards into the Lacteals of the ſecond Order, beyond them. We do not know of any Anatomiſt that has deſcribed this Structure before *Nuck*, which has been univerſally received by his Succeſſors.

[3] All the Lacteals enter ſome Gland or other of the Meſentery, but in their Paſſage they ride over and inveſt ſome Glands without entring them; and other Glands they paſs under in the ſame manner; but at thoſe Glands which they penetrate into, they are not loſt, but come out again at the oppoſite ſide of the Gland which they enter'd.

§. 118. From hence it appears, that nothing is ſeparated from the Chyle by the meſenteric Glands; but that the Chyle is by them *diluted*[1] with Lymph, and rendered more fluid in its Paſſage.

[1] It has been the Opinion of ſome conſiderable Anatomiſts, that the moſt ſubtil Part of the Chyle was abſorbed by the meſenteric Glands, the Remainder paſſing on thro' the Lacteals of the ſecond Order; but if any thing was ſeparated from the Chyle in thoſe Glands, it muſt either be of a thinner or thicker Conſiſtence than the Chyle itſelf; if it was thinner, the Remainder of the Chyle would be more inſpiſſated, which is contrary to Experience, by which we find that the Chyle in the Lacteals

Lacteals of the ſecond Order is more dilute; if it was thicker, it would then require Veſſels to convey it much larger than are thoſe of the Lymphatics, and conſequently they would be ſubject to our Obſervation or Inſpection.

§. 119. That the Chyle is thus diluted in the meſenteric Glands, will more evidently appear, if we conſider, that theſe *hollow* [1] Glands are every where ſupplied with Arteries, diſtributed up and down in a particular manner, and not wound up in a Bundle; that they are alſo ſupplied with many Nerves, and receive the Lymphatics, with their Lymph, from many *Viſcera* of the *Abdomen*; which mixing with the Chyle in theſe Glands, dilutes it, and renders it more fluid; the Chyle may alſo be diluted in theſe Glands by a thin Humour, ſeparated from the Extremities of the Arteries, diſtributed in their Cavities; which ſeems probable, from the Experiment of *Cowper*, who tells us, that *Mercury* injected by the meſenteric Arteries entered the Lacteals.

[1] The Structure of theſe Glands has been much controverted by Anatomiſts. *Nuck* will have them to be of a reticular Texture, bound up in a common Integument. *Malpighius* ſuppoſes Follicles or Cells interſperſed between the reticular Texture of Fibres, which ariſe from the common external and ſtrong Membrane which inveſt theſe Glands, which Cells he tells us are cover'd with the ſmall Arteries diſtributed upon their Membranes; he ſuppoſes theſe Cells receive and retain a Liquor, which is diſcharged by the excretory Ducts in theſe Glands into

into the Lacteals of the ſecond Order. *Ruyſch* informs us in his later Obſervations, that many ſmall Arteries enter the meſenteric Glands, and being diſtributed into exceeding ſmall Branches, terminate at their ultimate Diviſion in ſmall ſpherical Bodies like Grapes, which he alſo takes to be ſmall Veſſels. The Opinion of *Malpighius* and *Ruyſch* appear not to be repugnant to each other; but there ſeems to be ſomething concealed in their Structure, which we have never yet been able to diſcover; however, it is more than probable that the meſenteric Arteries diſcharge a Liquor at their Extremities, which mixes with the Chyle, or elſe there would be no neceſſity for ſuch a Number of them to be diſtributed to ſo ſmall Glands; which is alſo ſupported by *Cowper*'s Experiment; by which it appears that there is a free Paſſage thro' the meſenteric Arteries into the Lacteals. But there has been alſo particular Veins lately diſcovered by *Ruyſch*, and deſcribed in his excellent anatomical Collections, delineated in a Copper Plate, which he added in a Letter to myſelf; theſe Veins paſs under the meſenteric Glands, and ſeem to carry back the ſuperfluous Part of the nutritious Blood.

§. 120. The Chyle is therefore not only retarded, *mixed together* [1], and diluted in theſe Glands; but it is alſo probable, that it is further attenuated by the addition of a Fluid diſcharged from the *Nerves* [2].

[1] It is ſhook together and mixed by the Contraction of the external fibrous Coat, by the Vibrations of the Arteries and external Preſſure; which *Nuck* ſuppoſes to be the principal, if not the only Office of the meſenteric Glands.

[2] It

[2] It is obſervable that there are many Nerves diſtributed in the Meſentery, but they cannot be for Senſation, for that Part has hardly the common Senſe of feeling; nor can they be for muſcular Motion, which has no place here, but are all wove into a large *Plexus*, the moſt conſiderable in the *Abdomen*, well deſcribed by *Winſlow*, ſeated in the middle of the Meſentery, and largely expanded throughout the ſame: therefore as theſe Nerves do not appear to be ſubſervient to the fore-mentioned Uſes, there is room to ſuſpect that they diſcharge a Fluid into the Glands by their ultimate Branches, which mixing with the Chyle, renders it more fluid, and fit for Nutrition.

§. 121. The larger lacteal Veſſels *uniting* [1] again beyond the meſenteric Glands, proceed towards the *Receptacle* [2] of the Chyle at the Loins, opening into the ſame by a triple Orifice; by which is alſo diſcharged a large Quantity of *Lymph* [3], convey'd by the lymphatic Veſſels from almoſt all the Parts below the *Diaphragm*, as into a common Channel.

[1] Notwithſtanding theſe are larger, or leſs ramified, they are rather more plentifully ſupplied with Valves than thoſe of the firſt Order; which was neceſſary, to diminiſh the Reſiſtance of the Chyle, as the propelling Force of the Inteſtines becomes leſs.

[2] This Receptacle is formed by the Union of three or four of the laſt or largeſt Lacteals, as *Cant* demonſtrates, who firſt gave a good Deſcription of this Part; tho' it is ſometimes formed of but one or two Lacteals, varying according to the Number of larger Veſſels proceeding to the Receptacle,

tacle, which are ſometimes more, and ſometimes leſs; but the ſmall Glands of *Bartholin* are Collections or Convolutions of innumerable lymphatic Veſſels.

[s] The Lymph of almoſt all the *Viſcera* of the *Abdomen* and inferior Limbs, which makes no inconſiderable Quantity; for if two Ounces of Blood are expell'd by the Heart at each Contraction, and but one 16th Part of the whole Maſs be taken as Lymph, it will eaſily appear, that as 7200 Ounces of Blood paſs thro' the Heart in an Hour, the Quantity of Lymph in that time will be 4 or 500 Ounces, or above 37 Pounds; but that Quantity of Lymph much exceeds the Chyle diſcharg'd into this Receptacle, whence it is greatly diluted, and more eaſily aſſimilated. Theſe lymphatic Veſſels have been chiefly deſcrib'd by *Nuck*, whoſe Tables have been wrong eſteemed ſpurious, for I have a hundred times ſeen all the Lymphatics ſpread upon a Table; to do which, that expert Anatomiſt inſerts a ſmall ſharp pointed Tube of Steel into one of the leaſt Lymphatics, by which he injects Mercury amalgamed with Lead or Tin, ſo as to congeal when in the Veſſels; by this means he compoſed a complete Hiſtory of all the lymphatic Veſſels, a fair Specimen of which laborious Performance he has given us in his *Adenographia*, where he has accurately deſcribed the lymphatic Veſſels, as the Blood-Veſſels are uſually by other Anatomiſts; but Death too ſoon deprived us of that excellent Anatomiſt, to the great Damage of the Science.

§. 122. And that this is the conſtant Courſe of the Chyle and Lymph, is apparent from the *Valves* [t] in the Lacteals, and Experiments made

made with *Ligatures* [2], as well as from various *Diſeaſes* [3] of the Lymphatics.

[1] Which prevent the Paſſage of the Chyle, Water, or Mercury, from the Receptacle downwards towards the Inteſtines, but eaſily admit thoſe Fluids from the Inteſtines towards the Receptacle; ſo that the *Receptaculum Chyli* is a ſort of Heart or Fountain-head of all the Lymph of the *Abdomen*.

[2] Which being made upon the Lymphatics, cauſe them to ſwell between the Ligature and their Extremities, or Parts from whence they ariſe, but to become flaccid in that Part between the Ligature and Receptacle. If the *Abdomen* of a living Animal be expeditiouſly open'd, and a Ligature made about the *Pancreas Aſellii*, if warm Water be then injected into the *Abdomen*, the lymphatic Veſſels will be very turgid and conſpicuous; but if the Ligature be removed, they quickly become flaccid, and diſappear. In like manner, to demonſtrate the Lymphatics of the Head, a Ligature is made about the jugular Veins, as it was about the Receptacle of the Chyle, in order to demonſtrate the Lymphatics of the *Abdomen*. To this we may add, that if a Maſtiff Dog be ſtrangled, ſo as not to be quite dead, by opening the left Cavity of his *Thorax*, and preſſing with the Finger upon the thoracic Duct, when diſcover'd, it ſwells below the Finger, ſo as to be near burſting, and many of the lymphatic Veſſels are by that means render'd conſpicuous; but in this Operation the Anatomiſt ſhould be provided with ſeveral Sponges, ſome dipt in Water, others in Spirit of Vitriol, to waſh out the extravaſated Blood, and prevent a freſh Afflux. Add to this, that if a ſmall Tube be inſerted into a lymphatic Veſſel, and Air be inflated thereby, or ſome Li-

quor

quor injected, it will paſs into the *Cava* and Heart, and deſcribe the Courſe of the Blood; but if the Air and Liquor be injected towards the ſmaller Branches of the Lymphatic, it will find no Paſſage, by meeting with a Reſiſtance from the Valves.

[s] In the *Morbus Regius*, which is a kind of Jaundice, almoſt all the Glands in the Body are obſtructed and tumified, attended with a ſlow Conſumption. Upon opening Bodies diſeaſed with this Diſorder, the meſenteric Glands are uſually found ſchirrous, which obſtructing the Courſe of the Chyle, cauſe a Conſumption; and by denying a Paſſage to the Lymph, occaſions a Diſtenſion or Rupture of its Veſſels, whence proceeds one of the worſe Kinds of Dropſy, termed *Aſcites*.

§. 123. This lymphatic Juice, or Lymph, conſiſts of the pureſt, moſt aqueous, and ſpirituous or ſubtle Parts of the arterial Blood, and is impregnated with the moſt volatile of its Salts; as appears from the Nature of its ſecretory and excretory Organs, and from its ſenſible Qualities.

The Action of the thoracic Duct upon the Chyle.

§. 124. WHEN the Chyle has been diluted with the Lymph diſcharged into the Receptacle, and ſeparated from all the Parts below the *Diaphragm*, it is then, by the forementioned Cauſes (§. 113.) and eſpecially

cially by the Contraction of the *Diaphragm* [1] and Pulsation of the *Aorta* [2], pressed into and thro' the thoracic *Duct* [3] of *Pecquet*; which being full of Valves, ascends a little above its Insertion, and then dips down into the *right* [4] or left subclavian Vein (usually the last) opening in the Space between the external and internal Jugulars, and discharges the Chyle and Lymph, into the venal Blood of the *Subclavian* and *Cava*, by two semilunar *Valves* [5]; which meeting together, form an oblong Aperture or Slit, admitting the Chyle by a small Stream into the Vein, but preventing any Return of the venal Blood in the Thoracic Duct, into which is also discharged all the *Lymph* [6] from all Parts of the *Thorax*, whether *Viscus*, Membrane, or Muscle; as all the Lymph of the *Abdomen* was discharged into the Receptacle.

[1] As the Receptacle of the Chyle is lodg'd upon the *Vertebræ* of the Loins, between the muscular *Crura* of the *Diaphragm*, it must necessarily be compressed, and its Contents discharged at every Contraction of that Muscle in Respiration; but as the Chyle cannot pass downward by that Pressure, being prevented by the Valves, the Pressure of the *Diaphragm* will exert all its Force in propelling the Chyle upward into and thro' the thoracic Duct, which will be still promoted by the [2] *Diastole* of the *Aorta*, by the side of which the thoracic Duct is connected, and ascends.

[3] The thoracic Duct was first described by *Eustachius* in a Horse; after him it was first discover'd by *Pecquet* in a Dog, who by compressing the Mesentery,

ſentery, perceived the Chyle paſs through a ſmall Channel in the *Thorax*, and from thence into the Vein which in the Dog anſwers to the ſubclavian in Men; but as that Animal is deſtitute of Clavicles, the Veins are only denominated axillary. The ſame Duct was alſo delineated by him as it appeared in Dogs; but *Vanhorne* and *Bartholin* were the firſt that deſcribed it in a human Body; and ſince, *Cantius* has lately delineated it by large and neat Figures.

[4] The Deſcriptions of Anatomiſts vary with regard to the Inſertion of the thoracic Duct, Nature herſelf not always obſerving the ſame Rules therein; for the thoracic Duct has been obſerved to open into either of the ſubclavian Veins; it generally divides itſelf in the upper Part of the *Thorax*, and uniting again at the ſecond *Vertebra*, it aſcends a little above its Inſertion, and is then inflected downward to its Opening in the ſubclavian Vein, into which it is inſerted by a double Valve, like the *Inteſtinum Illium*, into the *Colon*; and not with a ſingle Valve, as it has been figur'd by *Lower* from Brutes. Provident Nature has taken care to place this Duct in a Part of the *Thorax* where it is in no danger of being compreſſed or wounded by external Injuries, which would ſoon put a Period to Life; as we learn from the Experiment of *Lower*, who lacerating the thoracic Duct in a Dog, obſerved that the Animal periſhed in a few Days, notwithſtanding he was ſupplied with the beſt Food; and upon opening him, his *Thorax* was found replete with Chyle.

[5] The Aperture of the Valve at the Inſertion of the thoracic Duct is diſpoſed in a different manner from the reſt of the Valves in the Veins, being in the Figure of a half Moon, ſo as to entirely cloſe up the Mouth of the thoracic Duct; and being

preſſed together by the Blood in its Paſſage to the Heart thro' the ſubclavian Vein, it will not admit any Part thereof into the Duct; but being a little way opened by the Chyle preſſed thro' the thoracic Duct by the fore-mention'd Forces, it admits that Fluid, with the Lymph that accompanies it, into the Blood.

[6] The whole Maſs of Lymph, which is ſeparated from the *Viſcera*, and other Parts of the *Thorax*, is all diſcharg'd into this Duct; upon tying which all the lymphatic Veſſels of the *Thorax* become turgid and diſtended with Lymph, it being deny'd a Paſſage into the Duct. There muſt certainly be ſome material Reaſon why the Creator ſhould rather cauſe all the Chyle in Quadrupeds to aſcend into the Blood by one large Duct, rather than let it be abſorbed by the numerous ſmall Veins of the Meſentery; and the moſt probable Reaſon for this Mechaniſm ſeems to be, that the Chyle ſhould receive a large Quantity of Lymph before it enters the Blood, in order to dilute and attenuate it; otherwiſe it might be apt to produce Obſtructions in the ſmall Veſſels of the Lungs, and occaſion a *Peripneumony*, or Inflammation of that *Viſcus*.

§. 125. Thus we are acquainted with the Means by which ſo large Quantities of Chyle and Lymph are eaſily convey'd thro' this *narrow*[1], crooked, and perpendicular Duct (which in part is, and may with eaſe be totally *compreſſed*[2]) into the Blood, and that even when a Man is in an erect Poſture. Theſe Means will ſufficiently appear, if we conſider, 1. The contractile Power of the Inteſtines, together with the Means (§. 103, 104, 86.) which aſſiſt the Expulſion of the Chyle out of them into the Lacteals.

cteals. 2. The *Valves*[3] in the Lacteals, Receptacle, and thoracic Duct, which are admirably adapted to take off the perpendicular Weight, and *expedite*[4] the Paſſage of the Chyle thro' them. 3. The Impulſe of the meſenteric Arteries, which either interſect or run parallel with the Lacteals in the Meſentery. 4. The ſtrong and alternate Preſſure of the abdominal Muſcles being returned by the *Peritonæum*[5] upon the ſoft, *thin*[6], and lax Membranes of the Meſentery, inveſting the Lacteals; together with, 5. The like Preſſure of the *Diaphragm* upon the Receptale. 6. The ſtrong and conſtant contractile *Niſus* of the Membranes, conſtituting the thoracic Duct itſelf, which appears to be *conſiderable*[7] by its Contraction, even after Death. 7. The ſtrong and inceſſant Pulſation of the *Aorta*[8], which aſcends by the Side of the thoracic Duct, and laſtly, 8. The Action of the Lungs and *Thorax* in Reſpiration.

[1] Small, if compar'd with the Quantity of Chyle and Lymph paſſing thro' it; which would be too large for this Duct, if it was not preſſed forward with a conſiderable Force and Velocity.

[2] The thoracic Duct is preſſed by the whole Weight of the Atmoſphere dilating the Lungs, which is ſufficient to ſuſtain a Column of Water in a Tube 32 Foot high, and a perpendicular Column of Mercury to the height of about 30 Inches; but the *Thorax* is fulleſt at the time of Inſpiration, when there is no Space left between the Lungs and the Ribs, and therefore the thoracic Duct muſt of neceſſity be compreſſed by the Lungs expanded

with Air in Inſpiration; and even when the weight of the Air is nothing in Expiration, it is preſſed by the Pulſation of the *Aorta*, *&c.*

[3] Which Valves ſuſtain the Weight of the Chyle, that it might not be thereby forc'd downward lower than the next ſubjacent Valve, which will by its Elaſticity re-act, and return the Force from the perpendicular Preſſure upon the Chyle again; which, with the external Preſſure, will cauſe it to aſcend. It is an Aſſertion of *Bilſius*, that the Chyle is diſtributed from the thoracic Duct, as from a Fountain, to the Breaſts, and all Parts of the Body; but he afterwards refutes his own Notions in his Commentary on the Valves.

[4] The Velocity with which the Air ruſhes into a *Vacuum*, has been formerly demonſtrated by *Pappin*; its Force has been alſo by me demonſtrated to be twice equal to the ſwifteſt Wind, which according to *Marriotte* runs 22 Feet in a Second; the Chyle will therefore run with a great Celerity in the thoracic Duct, ſince that Tube is divided into ſo many void Interſtices as it hath intercepting Valves; therefore if one Interſtice be empty'd, the Chyle will flow into it from the ſecond with a great Velocity; and ſo from the third into the ſecond, *&c.* ſucceſſively; which ſwift Motion was neceſſary, to prevent the Chyle from running into Concretions before it had arrived into the ſmall Veſſels of the Lungs.

[5] The Meſentery is not ſtretch'd down pendulous by the Weight of the Inteſtines, nor the Cavity of the *Abdomen* empty, as ſome have falſely imagin'd; but the whole lower *Venter* is quite full, and all its *Viſcera* compreſſed. If one inſerts their Finger at a Wound of the *Abdomen*, which has been by Accident inflicted upon a healthy Perſon, the Finger will be compreſſed with a greater Force than

than one would imagine. In Inſpiration the *Diaphragm* preſſes down all the *Viſcera* with a conſiderable Force towards the *Pelvis*, and there again preſſed upward by the abdominal Muſcles in Expiration, and therefore the Lacteals will be compreſſed by both; and thus the Chyle will be propell'd thro' them, partly by the Contraction of the Inteſtines themſelves, and partly by the Preſſure of the circumjacent Parts.

[6] Which, if it be not over diſtended with Fat, communicates the whole Preſſure which it receives to the ſubjacent Lacteals.

[7] Its conſtituent Membranes are thin, but elaſtic; for in a Body which has been not long froze to death, the thoracic Duct, which a little before appeared diſtended with Chyle, becomes the next Moment contracted, pellucid, and entirely emptied, ſo as to diſappear from the Eyes of the Spectators.

[8] Which is by ſome eſtimated to be more than equal to 100 Weight; to this we may add, that we have ſeen a Juggler at a Fair, who lying upon his Back, laid a heavy Anvil of Iron upon his Breaſt, which might be ſenſibly perceiv'd to aſcend at every Contraction of his Heart.

§. 126. The Effects therefore which the Chyle ſuffers in its Paſſage from the Inteſtines into the venal Blood, will appear reducible to the four following Heads, to which they may be referr'd, as

1. The Slowneſs of its Motion thro' the Inteſtines, Lacteals, and meſenteric Glands; which is demonſtrable from the great Length of the firſt, when ſtript from the Meſentery, and

from the Number and Minutes of the two laſt: The Effects of all which muſt be a Digeſtion and *Depuration*[1] of the Chyle from its groſſer Parts.

2. The Motion and Preſſure communicated externally to the Veſſels, and by the Veſſels to their contained Fluids; the Effects of which is, a Protruſion, Attenuation, and Mixture of the Chyle, with a Preſervation of its Fluidity. Here we ſhou'd conſider, (1.) The Poſition of the Lacteals, which gradually increaſe in Size, are all furniſh'd with Valves, and frequently open into each other; then recede, and preſently after unite again (*per* §. 116.) (2.) The ſtrong Preſſure of the *Diaphragm* and Muſcles of the *Abdomen*, with its compreſſed *Viſcera*, being returned upon the Lacteal Veſſels, which run almoſt on the outſide of the Meſentery, with hardly any Covering (§. 86.) (3.) The degree of *Heat*[2] and Moiſture adminiſter'd to the Chyle, moſt apt to promote Digeſtion, and produce Effects well known and obſerved by the Chemiſts. And (4.) The conſtant Pulſation of the *Aorta* on the thoracic Duct, and of the meſenteric Arteries upon the Lacteals, moſt of the laſt running cloſe by each other, ſo as to receive a vibratory Motion.

3. The Dilution of the Chyle, by mixing with, (1.) all the *Lymph*[3] of almoſt the whole Body; (2.) with the moiſt Dew or *Vapours*[4] in the *Abdomen*, which is chiefly abſorbed by the Lymphatics leading to the Receptacle; and we may add, (3.) that the Juice of the *Nerves*[5], mixing

mixing with the Lymph in all its conglobate Glands, contributes much to dilute and attenuate the Chyle.

4. The *Aſſimilation*[6] of the Chyle, to render it fit to circulate thro' all Parts of the Body, before it enters the venal Blood; which is done by meeting and mixing with various Humours, in its Paſſage from the Mouth to the ſubclavian Vein, (1.) It is gradually and ſucceſſively ſupplied and digeſted with Juices, which have been before elaborated in, and often circulated thro' all the Veſſels diſtributed throughout the *Body*[7]; as the *Saliva* and *Mucus* of the Mouth, Lymph and *Mucus* of the *Oeſophagus*, Stomach, Inteſtines, pancreatic Juice, cyſtic and hepatic Bile, the Lymph from all Parts of the Body; and probably the Juice from the ſmall Nerves in the lymphatic Glands of all Parts. (2.) And laſtly, it is accurately mix'd and attenuated by the united Force of the whole chylopoietic Machine, which contributes to thoſe Effects by the Figure, Diſpoſition, and Motion of its ſeveral Parts and Veſſels.

[1] By the great Length of the Inteſtines, the ſolid and excrementitious Part of the Chyle is retained and ſeparated, by their numerous Turnings, from the more fluid and uniform Part. The Chyle is found by Experience to be 24 or 30 Hours in its Paſſage thro' the Inteſtines, whereas it is not above 10 or 12 in paſſing the Lacteals; for upon opening an Animal eight Hours after a Meal, the Lacteals are found diſtended with Chyle; but the

next Day after they will appear to contain nothing but an excrementitious Lymph. The longer the Food is retained in the Inteſtines, the more Chyle is drawn off from it by the Lacteals; and that its Stay there is ſometimes very conſiderable, may appear from a healthy Man living at *Delph*, who did not go to ſtool oftner than once in 16 Days.

[2] Nature often produces Effects by a ſmall Force, which cannot be produc'd by more violent Means; thus all Animals are bred and brought to Perfection in a Heat of 94 Degrees; and it is not probable that there are any Animals whoſe Heat exceeds that of the human Body, ſince a human Heart bears a greater Proportion to the reſt of the Body than the Heart of an Ox, *&c.* All Vegetables are nouriſh'd and brought to Perfection by a Heat ſtill leſs than the fore-mentioned Degree; it being the Property of a Heat like that of the human Body, to attenuate all animal and vegetable Juices, and diſſolve them into exceeding ſmall Particles, ſo as to form a ſubtil Liquor; which Heat has uſually a greater Effect, in proportion as the Juices are retained in a more cloſe Place. We ſee by a Heat of 94 Degrees, the thick White of an Egg is in the Space of 22 Days ſufficiently attenuated to enter into and form the ſubtil Humours of the Chick.

[3] All the Lymph of the *Abdomen* is convey'd to the Receptacle of the Chyle, as that of the *Thorax* is into the thoracic Duct, while the Lymph which comes from the Head and Neck, is alſo diſcharg'd either into the thoracic Duct, or into the adjacent jugular Veins. This Lymph is eaſily diſtinguiſhable from the Chyle by its external Appearance and reddiſh Hue; and being much thinner than the Chyle, it dilutes the ſame, and renders it more eaſily convertible into animal Juices. This Lymph which is mix'd with the Chyle, is compos'd both

of

of that Lymph which is ſeparated from the lymphatic Arteries, and of all thoſe Juices in the human Body, which are of a more ſubtil Conſiſtence than the Lymph itſelf. Some indeed deny the Exiſtence of theſe lymphatic Arteries, becauſe their Eyes will not convince them; even the Microſcope will but juſt exhibit the ſmalleſt of the red or ſanguiferous Arteries, which being much larger, and conveying a colour'd Liquor, are more conſpicuous; whereas the lymphatic Arteries, which are ſo much ſmaller, and convey a pellucid Liquor, whoſe Globules are 6 times ſmaller than thoſe of the Blood, cannot be render'd viſible to the Eye, tho' armed with that Inſtrument. The other Part of the Lymph, compoſed of thoſe Juices in the Body, which are thinner than the Blood, will alſo appear to be conſiderable; for all the animal Juices ſeparated from the Blood, return again into the Circulation, except what is diſcharged by the Kidneys and Skin; all the other Juices return again from their Sources by the reductory Veins: and if there are any other Veins beſides thoſe which convey Blood, they muſt be the valvular Lymphatics; the return'd Juices are therefore convey'd by the Lymphatics to, and mix'd with the Chyle.

4 *Hippocrates* diſtinguiſh'd the ſolid Parts of the human Body into Cavities and Veſſels; the Cavities in a healthy Body, he ſays, are full of Vapours, but in a diſeaſed Body full of ſharp Humours, or *Ichor*. And it is certain that all the Cavities and Interſtices in the human Body are ſupplied with a warm and moiſt Vapour, which renders the Membranes and muſcular Fibres pliable and fit for motion, and prevents them from adhering to each other. But this Vapour is never diſcharged in ſuch Quantities as to turn into Liquor, and prove offenſive; for upon opening the *Thorax* or *Abdomen*

of

of a living Brute, nothing but a Vapour exhales, without any Water remaining; this Vapour muſt therefore return again into the Blood, which it can do by no other Veſſels that we are yet acquainted with, than the lymphatic Veins. Dogs have a communicating Paſſage from their Teſticles into the Cavity of their *Abdomen*; which is not found in Men. *Nuck* therefore wounded the *Scrotum* of a Dog, and injected a Pound of Water thereby into the Cavity of the *Abdomen*, ſewing up the Wound after the Operation; the Dog afterwards voided all the Water by Urine within the Space of three Days, ſo that no Part thereof was found remaining in the *Abdomen*; there muſt therefore be an open and continued Paſſage from the Cavity of the *Abdomen* to the Receptacle of the Chyle. The warm and ſubtil Vapour which is natural to the Body, will be therefore much more eaſily admitted by the ſame Veſſels, tho' its Quantity be not inconſiderable; which is argued by the Largeneſs of the Cavities which are moiſtened therewith, as thoſe of the *Pelvis*, *Scrotum*, *Abdomen*, *Thorax*, *Pericardium*, *Cranium*, Ventricles of the Brain, Cavity of the Lungs, Stomach, Inteſtines, *&c.* The ſame is alſo argued from the ſudden Increaſe of a Dropſy, where the Veſſels are not affected, but only the Abſorption of this Vapour obſtructed. As this Vapour therefore appears to be ſo copious, it muſt have no ſmall Share with the other Part of the Lymph in aſſimilating the Chyle, and rendring it more eaſily convertible into Blood and other Juices proper to the human Body.

5 The nervous Juice, which we ſuppoſe to be mixed with the Lymph, muſt be very much ſubliz'd by paſſing thro' the many Series of the ſmalleſt Veſſels before it enters the ſmaller Cavities of the Nerves; but we do not propoſe this as certain,

but

but probable, as we are not led thereto by the full Evidence of our Senſes and Experiments, but barely by Reaſon and Analogy.

[6] The human Body would never continue in that State in which it appears, if it was not to be conſtantly repair'd and renew'd; which is perform'd by Aſſimilation, or the Converſion of the crude and foreign Parts of the Chyle into animal Solids and Fluids of our own Nature. To facilitate this Change or Converſion of the Aliment, provident Nature has cautiouſly ſupplied the Chyle with a large Quantity of a Fluid, partaking of all the Juices in the Body, except the Blood, that it might not be pour'd crude into the Veins: thus the Chyle contains a Quantity of Bile capable of being again ſeparated under the Form of that Juice; a Quantity of *Saliva*, which will again return by the ſalival Glands; and ſo of the Lymph, *&c.* inſomuch that the crude Part of the Chyle will be little or nothing comparatively, and almoſt loſt in the large Quantity of Juices which are already proper to the Animal; as a little Vinegar loſes its Strength in a large Quantity of Honey.

[7] We need not wonder that a Pound of vegetable Juices ſhould be converted from their own Nature into animal Subſtance, if we conſider that it mixes with above 24 Pounds of animal Juices, with which it is intimately mixed and digeſted in its Paſſage from the Mouth before it reaches the venal Blood. Were the nutritious Juices of our Food to be conveyed into the Blood without this Mixture, they would be deſtructive rather than preſervative to the Animal; as may appear from the Diſeaſes which are ſo frequent and epidemical in theſe Parts ſoon after the yearly Charity of diſtributing Food to the Poor. But the Principal of theſe animal Juices is the Bile, a kind of liquid Soap,

Soap, ſo acrimonious, that Nature could not prepare it in any of the Veſſels, but digeſts it in a diſtinct Cell, the Gall-bladder, where it becomes thicker and ſtronger by its Stay and Heat of the Party; nor do I believe there is any ſincere Bile contained in any of the other Veſſels in the whole human Body.

127. If we now examine the Subſtance of the Chyle when arriv'd thus far, we ſhall find it conſiſt of all thoſe Principles which compoſe Blood; as *Water*[1], Spirit, Oil and Salts, intimately mix'd and united together.

[1] All theſe Principles are alſo contained in the Food itſelf, of which the Chyle is formed. In this Place it ſeems of Importance to take notice of *Lewenhoeck*'s Obſervations, that all the nutritious Juices, upon which we live, are compoſed of ſmall Globules, which are uſually larger than thoſe of the Blood, but of a laxer Texture, and more eaſily diviſible. When theſe Juices of our Food have been converted into Chyle, there then appears to be but few of the larger Globules, but a great Number of the ſmaller, into which the larger ſeem to have been diſſolved; theſe by their greater Tenuity are more eaſily abſorbed by the Veſſels, and paſs more freely thro' them; it then remains that theſe ſmaller Globules be united into larger and more compact ones, like thoſe of the Blood, after the Chyle has arriv'd into the ſecond Paſſages, or Blood-Veſſels. The uniform Nature of the Chyle is apparent from its ſenſible Qualities, its ſmooth or even Taſte and Fluidity, the ſpherical Figure of its Particles, it being inodorous, *&c.*

§. 128. Nor

§. 128. Nor is it ſurpriſing that *Diſorders* [1] ſo ſeldom happen in the Meſentery, notwithſtanding it ſeems to be greatly ſubjected to obſtruction, and its Conſequences, from its Veſſels being the firſt that receive the crude Chyle; to prevent which, Nature has every where uſed the ſtricteſt Precaution.

[1] Even in old Men of 90 Years of Age the Meſentery generally appears ſound and entire, except that its Glands are uſually ſhrunk or contracted. And the Chyle itſelf is a ſubtil Liquor, that has undergone many Depurations, is abſorbed by the ſmalleſt Veſſels, and does not ſtagnate, but is conſtantly protruded with a conſiderable Force and Velocity thro' the Lacteals, by the Action of the *Diaphragm* and *Aorta*, its Paſſage being ſtill promoted by the numerous Valves in the Lacteals; not to mention the Efficacy of the Vapours, in which the Meſentery is ſuſpended in the *Abdomen*, to prevent and diſſipate Obſtructions. But notwithſtanding all this Proviſion of Nature, Obſtructions are often formed in the Meſentery, either from a Coagulation of the Chyle, or Concretion of thoſe Parts in the ſmalleſt Veſſels, which had been diſſolved in the Inteſtines, promoted by a weak Habit and inactive Life; by which means the Chyle, not being propelled forward with a proper Force, ſtagnates, concretes together, and while its more fluid Part is drained off, the Remainder has been ſometimes obſerved to put on a ſtony Conſiſtence; whence ſtrumous Glands of the Meſentery and Pancreas, which frequently occur in thoſe who are ſubject to Strumoſity of the Glands in the Throat; but ſtrumous Glands of the Neck are not to be eſteemed either the Cauſe or Effect of ſtrumous

ſtrumous Glands in the Meſentery, tho' they are uſual Companions, and proceed from the ſame latent Cauſe.

§. 129. We are from hence alſo informed, that the thoracic Duct ſerves not only to convey the Chyle, but alſo the *Lymph*[1] into the Blood, and perhaps a Part of the nervous Juice; upon which account I frequently call the thoracic Duct the *Vena Cava*[2] of the Lymph, from its ſimilitude to that Veſſel; for as the one returns all the Blood mixed together towards the Heart, ſo this returns the Chyle, Lymph, and all the more ſubtil Juices; hence in dead Subjects, after faſting, this Duct reſembles a large Lymphatic fill'd with a pellucid Liquor.

[1] The Lacteals convey Chyle to the Quantity of a Pound or two, only during the time of Digeſtion; at other times they are pellucid, not differing from the Lymphatics, as they then only return the *Saliva*, Juices of the Stomach and Inteſtines, with the thin hepatic Bile and inſipid Juice of the *Pancreas*. In long faſting the Lacteals and their Orifices are kept open, and from cloſing, by the Return of theſe Juices, and the great Quantity of Lymph which is that way conſtantly returned into the Blood; which was the more neceſſary, as empty Veſſels in the human Body quickly collapſe and grow together.

[2] As being the common reductory Channel of all the Juices in the human Body, which are thinner than the Blood itſelf. This Duct is much ſmaller than the ſanguiferous *Vena Cava*, becauſe it was neceſſary

neceſſary that the Chyle ſhould paſs thro' it with a greater Velocity than the Blood thro' the former.

§. 130. Having thus traced the Paſſage of the Chyle into the Veins; in order to underſtand its further Progreſs and Changes, it will be neceſſary to conſider the Circulation of the Blood, with which it now mixes, and the Conſequences thereof; which we ſhall therefore make the Subject of our next Diſcourſe.

The Chyle now pours itſelf into the purple Ocean of the Blood, and never after appears ſeparately under any other Form or Name but that of Milk, which is found circulating in the Veins of live Animals about three or four Hours after a Meal, retaining its white Colour diſtinct, according to the Obſervation of *Lower*.

F I N I S.

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